

Chapter 2 Part C

2.5L four-cylinder engine

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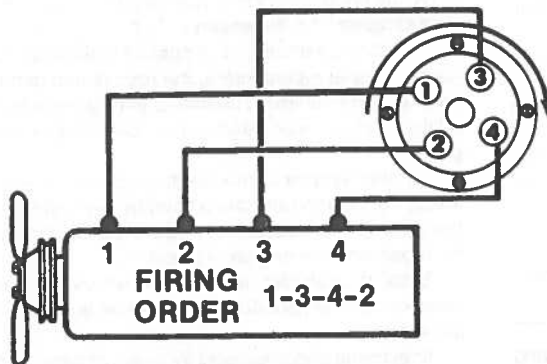
Specifications

General

Cylinder numbers (front-to-rear)	1-2-3-4
Firing order	1-3-4-2

Camshaft

Lobe lift (intake and exhaust)	0.398 inch
Bearing journal diameter	1.869 inches
Bearing oil clearance	0.0007 to 0.0027 inch
Gear/thrust plate end clearance	0.0015 to 0.0050 inch



Cylinder locations
and firing order

Torque specifications

Ft-lbs (unless otherwise indicated)

Cylinder head bolts	
1985	92
1986	90
1987 on (see illustration 10.25)	
Step 1 - all bolts, in sequence	18
Step 2 - all bolts, except 9, in sequence	22
Step 2 - bolt 9	30
Step 3 - all bolts, except 9, in sequence	Turn an additional 120-degrees
Step 3 - bolt 9	Turn an additional 90-degrees
Intake manifold-to-cylinder head bolts	
1985	29
1986 (see illustration 8.15)	
Bolts 1, 2 and 6	38
Bolts 3, 4 and 5	25
Bolt 7	37
1987 on	25
Exhaust manifold bolts	
1985	44
1986 on (see illustration 9.13)	
Bolts 1, 2 and 7	36
Bolts 3, 4, 5 and 6	32
Flywheel-to-crankshaft bolts	
1985	44
1986	55
1987 on	65
Driveplate-to-crankshaft bolts	
1985	44
1986 on	55
Crankshaft pulley hub-to-crankshaft bolt	160
Lifter guide retainer-to-block stud	90 in-lbs
Oil pan bolts	
1985	75 in-lbs
1986 on	90 in-lbs
Oil pick-up tube bracket nut	37
Oil pump-to-block bolts	22
Pushrod cover nuts	90 in-lbs
Rocker arm bolts	
1985 and 1986	20
1987 on	24
Valve cover bolts	
1985 and 1986	72 in-lbs
1987 on	48 in-lbs
Timing gear cover bolts	90 in-lbs
Camshaft thrust plate bolts	90 in-lbs

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the 2.5 liter four-cylinder engine. Information concerning engine removal and installation, as well as engine block and cylinder head overhaul, is in Part F of this Chapter.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps included in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the engine and procedures in this Part. The Specifications necessary for rebuilding the block and cylinder head are found in Part F.

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. A clean engine will make the job easier and will help keep dirt out of the internal areas of the engine.

Depending on the components involved, it may be necessary to remove the hood to improve access to the engine as repairs are performed (see Chapter 11 if necessary).

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, oil pan gasket and cylinder head gasket are all accessible with the engine in place.

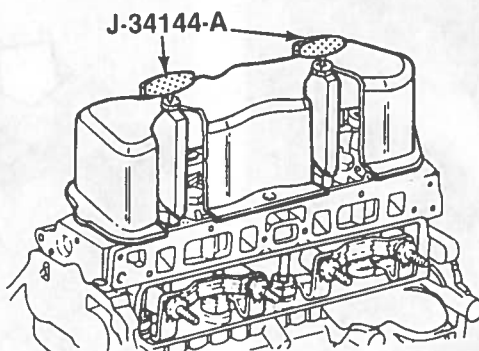
Exterior engine components such as the intake and exhaust manifolds, the oil pan (and the oil pump), the water pump, the starter motor, the alternator, the distributor and the fuel injection system can be removed for repair with the engine in place.

Since the cylinder head can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle.

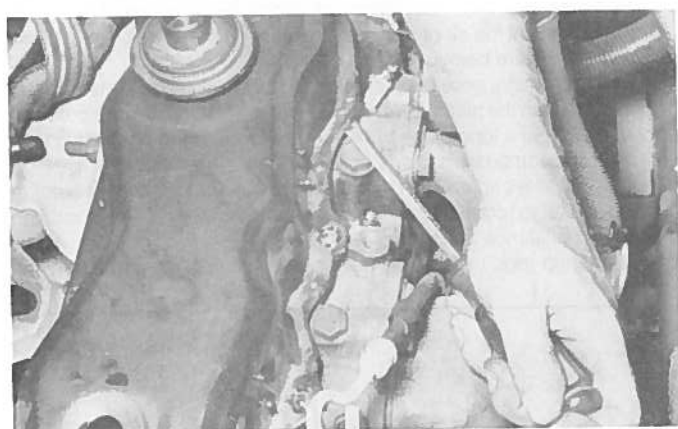
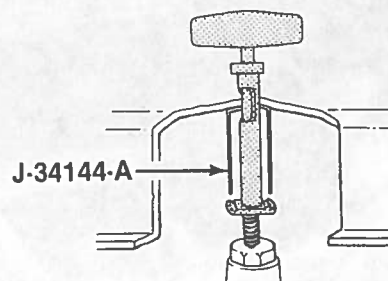
In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is



3.3 The PCV valve can be pulled out of the rubber grommet in the valve cover (leave the hose attached to the valve)



3.8 GM recommends a special tool for valve cover removal – if you're careful not to distort the cover, you can get by without it!



3.9 The valve cover is sealed with RTV – if you have to pry it off the head, try to avoid bending the flange



3.10 Remove the old sealant from the valve cover flange and the cylinder head with a gasket scraper, then clean the mating surfaces with lacquer thinner or acetone

possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

3 Valve cover – removal and installation

Refer to illustrations 3.3, 3.8, 3.9, 3.10, 3.11a and 3.11b

- 1 Disconnect the negative battery cable from the battery, then remove the air cleaner assembly.
- 2 Unbolt the dipstick and oil filler tubes at the water outlet.
- 3 Remove the PCV valve from the valve cover (see illustration).
- 4 Label each spark plug wire before removal to ensure that all wires are reinstalled correctly, then remove the wires from the plugs (see Chapter 1). Detach the wires and retaining clips from the valve cover.
- 5 Remove the EGR valve (see Chapter 6).
- 6 Detach the vacuum rail at the intake manifold and water outlet.
- 7 Remove the valve cover bolts.
- 8 Starting with 1987 models, a special tool (GM no. J34144-A) is recommended for valve cover removal (see illustration).
- 9 Remove the valve cover. If it sticks to the head, use a soft-face hammer or a block of wood and a hammer to dislodge it. If the cover still won't come loose, pry on it carefully at several points until the seal is broken, but don't distort the cover flange (see illustration). **Note:** If you bend the cover, straighten it with a block of wood and a hammer.

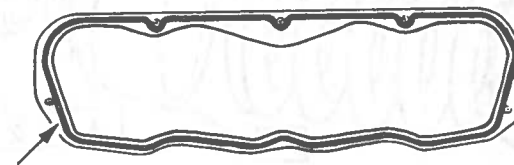
- 10 Prior to reinstallation, remove all dirt, oil and old gasket material from the cover and cylinder head with a scraper (see illustration). Clean the mating surfaces with lacquer thinner or acetone.

- 11 Apply a continuous 3/16-inch (5 mm) diameter bead of RTV sealant to the flange on the cover. Be sure the sealant is applied to the inside of the bolt holes (see illustrations). **Note:** Don't get the sealant in the bolt holes in the head or damage to the head may occur.

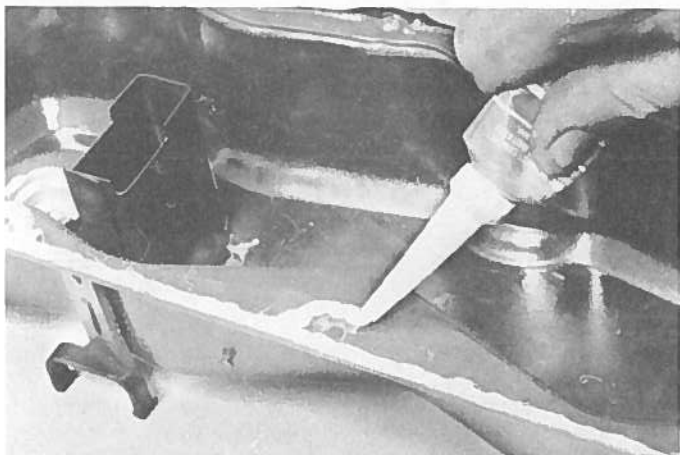
- 12 Place the valve cover on the cylinder head while the sealant is still wet and install the mounting bolts. Tighten the bolts a little at a time until the torque listed in this Chapter's Specifications is reached.

- 13 Complete the installation by reversing the removal procedure.

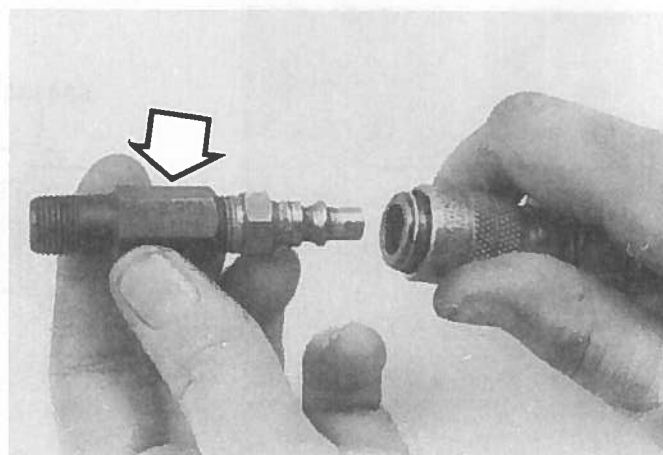
- 14 Start the engine and check for oil leaks at the valve cover-to-head joint.



3.11a Apply a continuous 3/16-in diameter bead of RTV sealant (arrow) to the valve cover flange



3.11b Make sure the sealant is applied to the **INSIDE** of the bolt holes or oil will leak out around the bolt threads



4.4 This is what the air hose adapter that threads into the spark plug hole looks like – they're commonly available from auto parts stores

4 Valve springs, retainers and seals – replacement

Refer to illustrations 4.4, 4.8a, 4.8b, 4.16 and 4.17

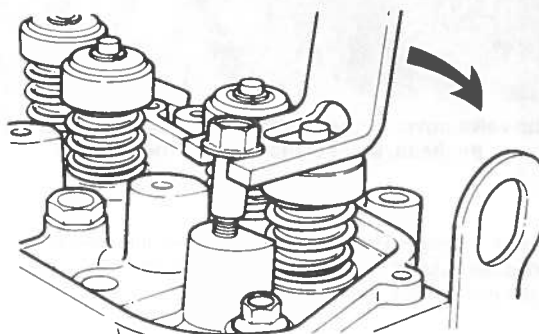
Note: Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Two special tools and a compressed air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job. If compressed air isn't available, a length of nylon rope can be used to keep the valves from falling into the cylinder during this procedure.

- 1 Remove the valve cover (see Section 3).
- 2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.
- 3 Turn the crankshaft until the piston in the affected cylinder is at top dead center on the compression stroke (see Section 13 for instructions). If you're replacing all of the valve stem seals, begin with cylinder number one and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing order sequence (1-3-4-2).
- 4 Thread an adapter into the spark plug hole and connect an air hose from a compressed air source to it (see illustration). Most auto parts stores can supply the air hose adapter. **Note:** Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.
- 5 Remove the bolt, pivot ball and rocker arm for the valve with the defective part and pull out the pushrod. If all of the valve stem seals are being replaced, all of the rocker arms and pushrods should be removed (see Section 6).
- 6 Apply compressed air to the cylinder. The valves should be held in place by the air pressure. If the valve faces or seats are in poor condition,

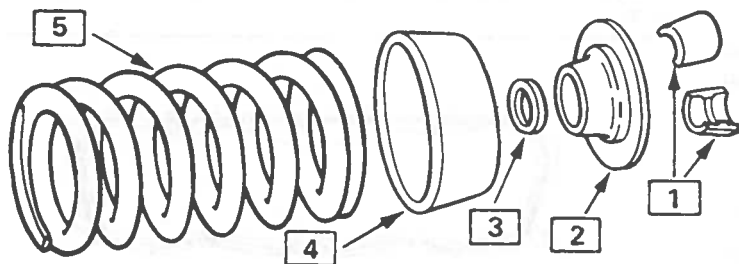
leaks may prevent the air pressure from retaining the valves – see the alternative procedure below.

7 If you don't have access to compressed air, an alternative method can be used. Position the piston at a point just before TDC on the compression stroke, then feed a long piece of nylon rope through the spark plug hole until it fills the combustion chamber. Be sure to leave the end of the rope hanging out of the engine so it can be removed easily. Use a large breaker bar and socket to rotate the crankshaft in the normal direction of rotation until slight resistance is felt.

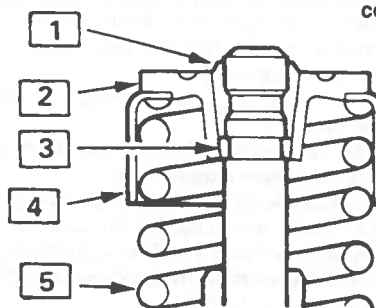
8 Stuff shop rags into the cylinder head holes above and below the



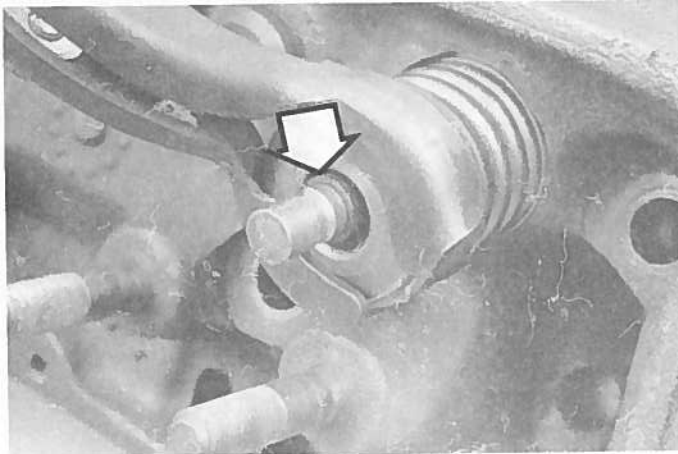
4.8a A lever-type valve spring compressor is used to compress the spring and remove the keepers to replace valve seals or springs with the head installed



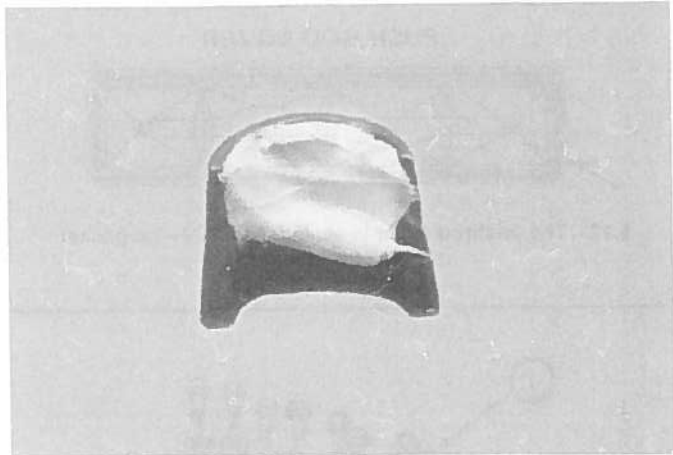
4.8b Exploded view of a valve and related components (later models are slightly different)



- 1 Keepers
- 2 Retainer
- 3 O-ring seal
- 4 Shield
- 5 Spring



4.16 Make sure the O-ring seal under the retainer is seated in the groove and not twisted before installing the keepers



4.17 Keepers don't always stay in place, so apply a small dab of grease to each one as shown here before installation – it'll hold them in place on the valve stem as the spring is released

valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring (see illustration). Remove the keepers with small needle-nose pliers or a magnet (see illustration). **Note:** A couple of different types of tools are available for compressing the valve springs with the head in place. One type grips the lower spring coils and presses on the retainer as the knob is turned, while the other type, shown here, utilizes the rocker arm bolt for leverage. Both types work very well, although the lever type is usually less expensive.

9 Remove the valve stem O-ring seal, spring retainer, shield and valve spring, then remove the umbrella type guide seal, if equipped (the O-ring seal will most likely be hardened and will probably break when removed, so plan on installing a new one each time the original is removed). **Note:** If air pressure fails to hold the valve in the closed position during this operation, the valve face or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.

10 Wrap a rubber band or tape around the top of the valve stem so the valve will not fall into the combustion chamber, then release the air pressure. **Note:** If a rope was used instead of air pressure, turn the crankshaft slightly in the direction opposite normal rotation.

11 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.

12 Move the valve up-and-down in the guide and make sure it doesn't bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the head will have to be removed for repair.

13 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem. If a rope was used instead of air pressure, rotate the crankshaft in the normal direction of rotation until slight resistance is felt.

14 Lubricate the valve stem with engine oil and install a new umbrella type guide seal, if used.

15 Install the spring and shield in position over the valve.

16 Install the valve spring retainer. Compress the valve spring and carefully install the new O-ring seal in the lower groove of the valve stem. Make sure the seal isn't twisted – it must lie perfectly flat in the groove (see illustration).

17 Position the keepers in the upper groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary (see illustration). Remove the pressure from the spring tool and make sure the keepers are seated. Check the seals with a vacuum pump (see Chapter 2, Part F).

18 Disconnect the air hose and remove the adapter from the spark plug hole. If a rope was used in place of air pressure, pull it out of the cylinder.

19 Install the rocker arm(s) and pushrod(s) (see Section 6).

20 Install the spark plug(s) and hook up the wire(s).

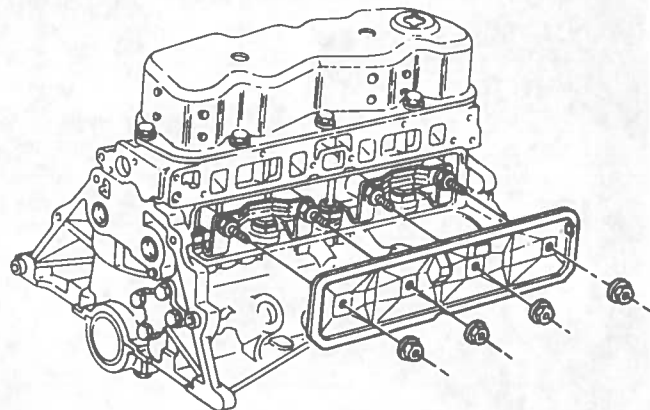
21 Install the valve cover (see Section 3).

22 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

5 Pushrod cover – removal and installation

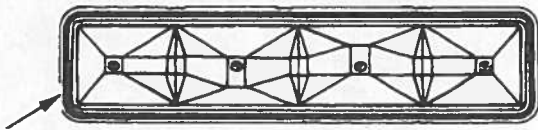
Refer to illustrations 5.9, 5.12 and 5.13

- 1 Disconnect the negative cable from the battery.
- 2 Remove the air cleaner assembly (see Chapter 4).
- 3 Remove the alternator and brackets (see Chapter 5).
- 4 Remove the intake manifold-to-block brace.
- 5 Drain the cooling system (see Chapter 1).
- 6 Detach the lower radiator and heater hoses.
- 7 Remove the oil pressure sending unit.
- 8 Detach the wiring harness brackets from the cover.
- 9 Remove the four pushrod cover nuts (see illustration). Flip one nut over so the washer faces out and reinstall it on the long inner stud. Put a second nut on the stud with the washer facing in. Put two 6 mm nuts on the shorter stud. Jam them together with two wrenches. Unscrew the studs by turning the inner nuts until the cover breaks free.
- 10 Remove the pushrod cover. **Caution:** Careless prying may damage the sealing surface of the cover. If you bend the cover during removal, place it on a flat surface and straighten it with a soft-face hammer.
- 11 Remove all traces of old gasket material with a scraper, then clean the mating surfaces with lacquer thinner or acetone.

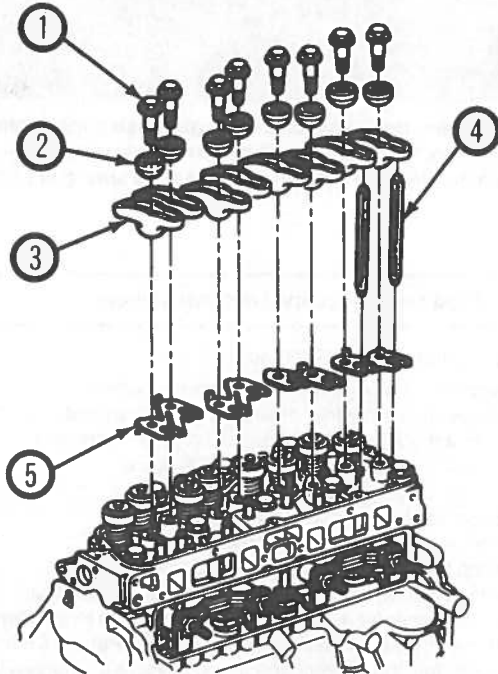


5.9 The pushrod cover is held in place with four nuts

PUSH ROD COVER

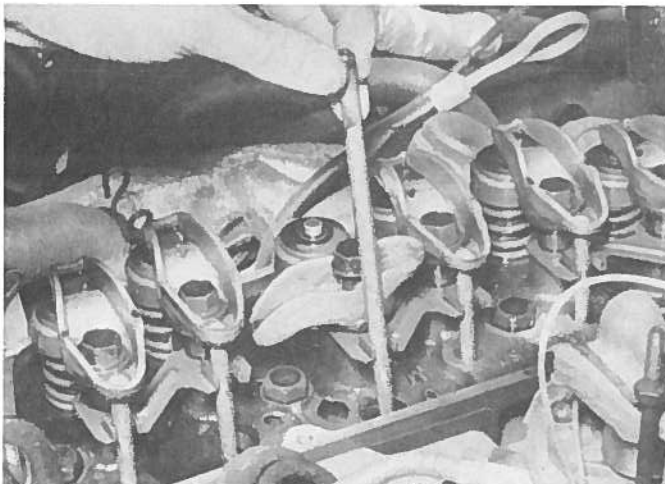


5.12 The pushrod cover is sealed with RTV – no gasket is required

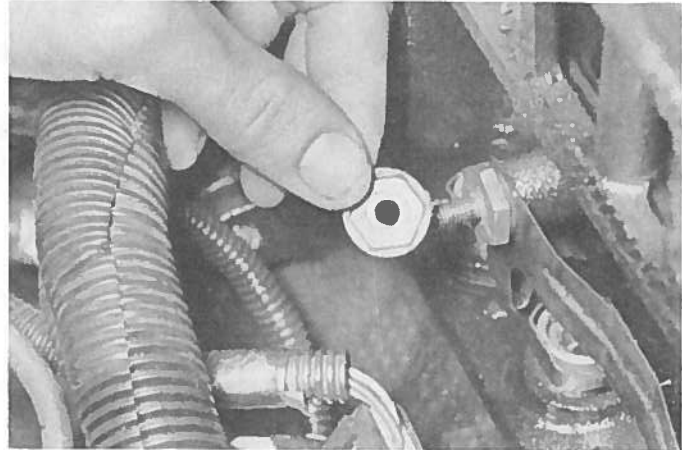


6.3 Rocker arms, pushrods and related components – exploded view

- | | |
|-------------------|-----------------|
| 1 Rocker arm bolt | 4 Pushrod |
| 2 Pivot ball | 5 Pushrod guide |
| 3 Rocker arm | |



6.4a Loosen the rocker arm bolt, rotate the rocker arm to one side and lift out the pushrod



5.13 Don't forget to install new rubber sealing washers around the pushrod cover mounting studs or oil will leak past the studs

- 12 Apply a continuous 3/16-inch diameter bead of RTV sealant to the mating surface of the pushrod cover (see illustration).
- 13 Install new rubber pushrod cover seals (see illustration).
- 14 Install the cover while the sealant is still wet. Make sure the semicircular cutout in the edge of the pushrod cover is facing down.
- 15 Tighten the nuts gradually until they're snug, then tighten them to the torque listed in this Chapter's Specifications.
- 16 The remaining installation steps are the reverse of removal.
- 17 Start and run the engine, then check for oil and coolant leaks.

6 Rocker arms and pushrods – removal, inspection and installation

Refer to illustrations 6.3, 6.4a, 6.4b and 6.5

Removal

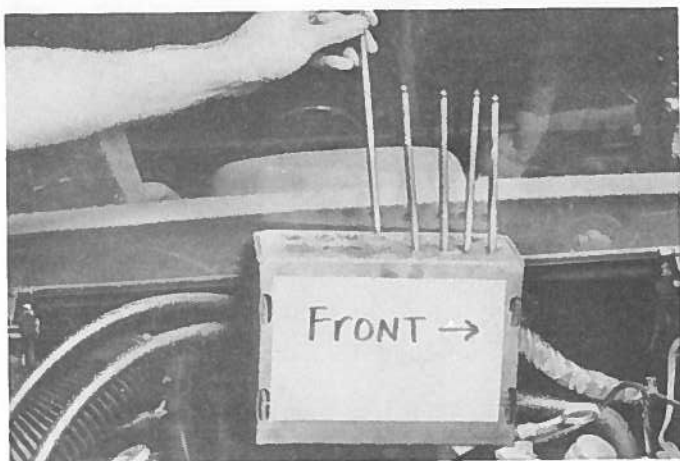
- 1 Detach the valve cover from the cylinder head (see Section 3).
- 2 Beginning at the front of the cylinder head, loosen the rocker arm bolts. **Note:** If the pushrods are the only items being removed, rotate the rocker arms to one side so the pushrods can be lifted out.
- 3 Remove the bolts, the rocker arms and the pivot balls (see illustration) and store them in marked containers (they must be reinstalled in their original locations).
- 4 Remove the pushrods and store them separately to make sure they don't get mixed up during installation (see illustrations).
- 5 If the pushrod guides must be removed for any reason, make sure they're marked so they can be reinstalled in their original locations (see illustration).

Inspection

- 6 Check each rocker arm for wear, cracks and other damage, especially where the pushrods and valve stems contact the rocker arm faces.
- 7 Make sure the hole at the pushrod end of each rocker arm is open.
- 8 Check each rocker arm pivot area for wear, cracks and galling. If the rocker arms are worn or damaged, replace them with new ones and use new pivot balls as well.
- 9 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a piece of plate glass to see if it's bent (if it wobbles, it's bent).

Installation

- 10 Lubricate the lower ends of the pushrods with clean engine oil or moly-base grease and install them in their original locations. Make sure each pushrod seats completely in the lifter socket.
- 11 Apply moly-base grease to the ends of the valve stems and the upper ends of the pushrods before positioning the rocker arms and installing the bolts.



6.4b If more than one pushrod is being removed, store them in a perforated cardboard box to prevent mix-ups during installation—note the label indicating the front of the engine

12 Set the rocker arms in place, then install the pivot balls and bolts. Apply moly-base grease to the pivot balls to prevent damage to the mating surfaces before engine oil pressure builds up. Tighten the bolts to the torque listed in this Chapter's Specifications.

7 Hydraulic lifters – removal, inspection and installation

Removal

Refer to illustrations 7.7a, 7.7b, 7.8 and 7.9

1 A noisy valve lifter can be isolated when the engine is idling. Place a length of hose or tubing near the position of each valve while listening at the other end. Or remove the valve cover and, with the engine idling, place a finger on each of the valve spring retainers, one at a time. If a valve lifter is defective, it'll be evident from the shock felt at the retainer as the valve seats.

2 The most likely cause of a noisy valve lifter is a piece of dirt trapped between the plunger and the lifter body.

3 Remove the valve cover (see Section 3).

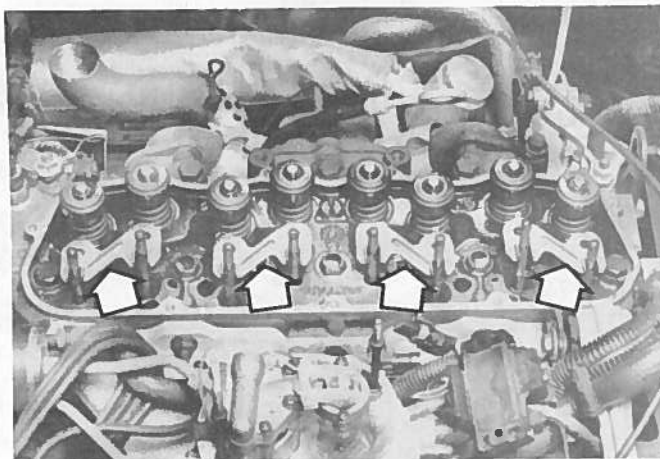
4 Loosen both rocker arm bolts at the cylinder with the noisy lifter and rotate the rocker arms away from the pushrods.

5 Remove the pushrod guides and pushrods (see Section 6).

6 Remove the pushrod cover (see Section 5).

7 Remove the lifter guide retainer by unscrewing the locknuts on the pushrod cover studs. Remove the lifter guide (see illustrations).

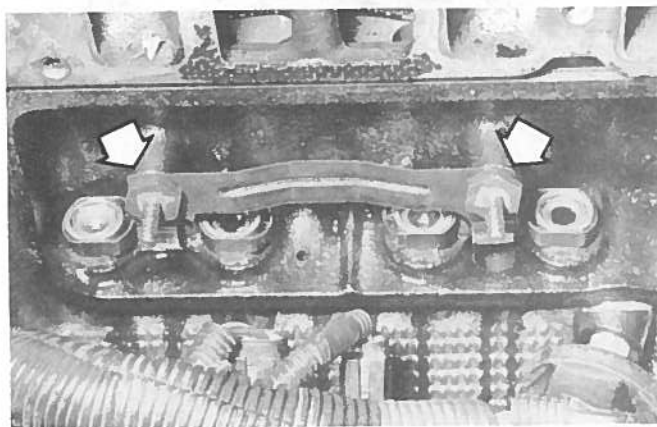
8 There are several ways to extract a lifter from its bore. A special re-



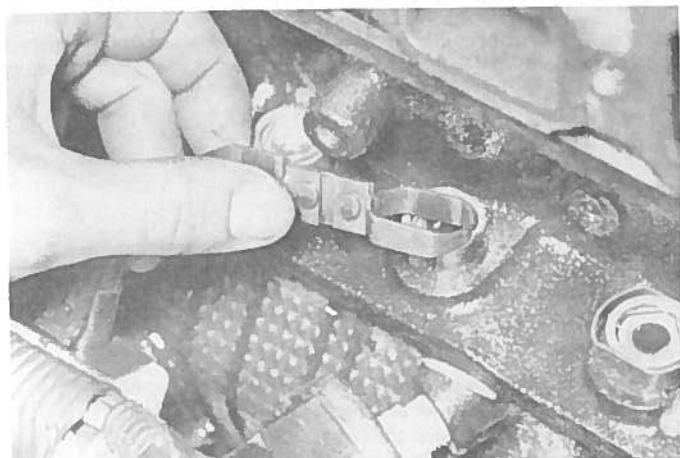
6.5 If they're removed, make sure the pushrod guides (arrows) are kept in order also

moval tool is available, but isn't always necessary. On newer engines without a lot of varnish buildup, lifters can often be removed with a small magnet or even with your fingers (see illustration). A scribe can also be used to pull the lifter out of the bore. **Caution:** Don't use pliers of any type to remove a lifter unless you intend to replace it with a new one—they will damage the precision machined and hardened surface of the lifter, rendering it useless.

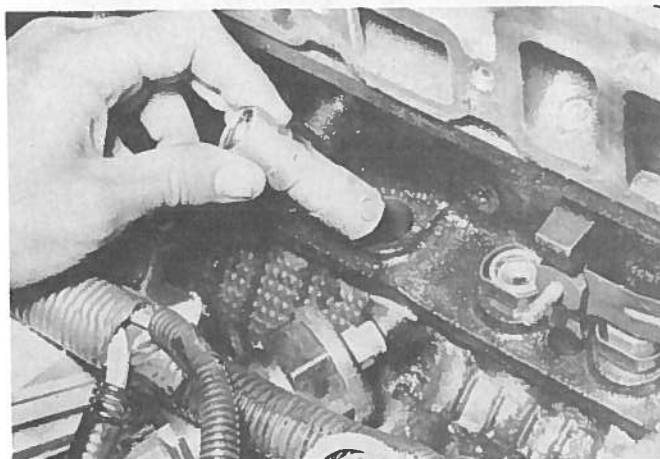
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7.7a Pushrod cover stud locknuts (arrows) – manifold removed for clarity



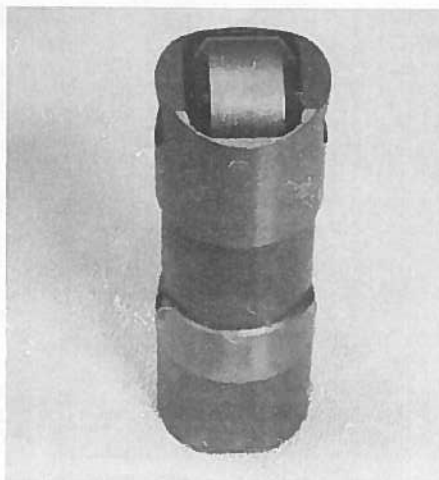
7.7b Remove the lifter guide – if you're removing more than one guide, keep them in order to prevent mix-ups during installation



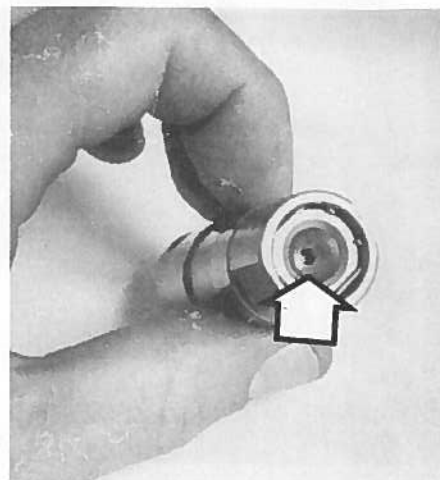
7.8 On engines that haven't become sticky with sludge and varnish, the lifters can usually be removed by hand



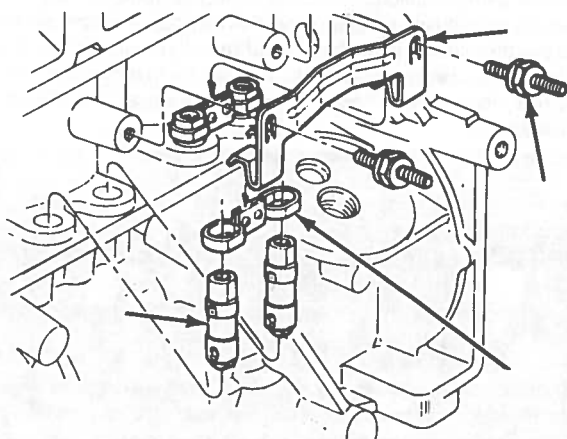
7.9 If you're removing more than one lifter, keep them in order in a clearly labelled box



7.11a The roller on the bottom of the lifter must turn freely – check for wear and excessive play as well

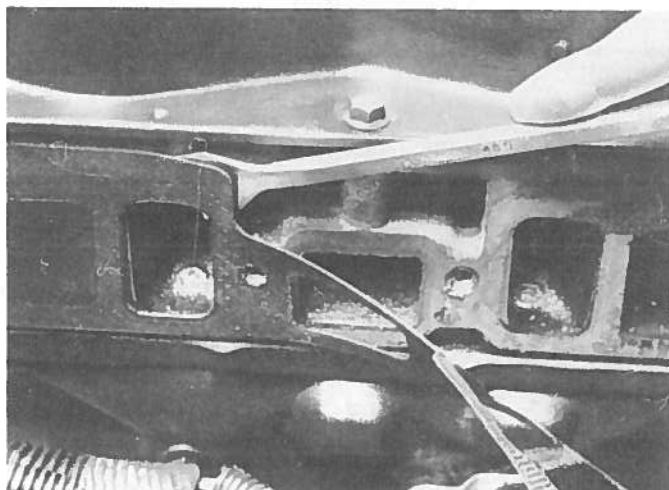


7.11b Check the pushrod seat (arrow) in the top of each lifter for wear



7.16 Hydraulic lifters and related components – exploded view

- | | |
|------------|----------------|
| 1 Retainer | 3 Lifter guide |
| 2 Stud | 4 Lifter |



8.10 Remove the old intake manifold gasket with a scraper – don't leave any material on the mating surfaces

9 Store the lifters in a clearly labelled box to insure their reinstallation in the same lifter bores (see illustration).

Inspection

Refer to illustrations 7.11a and 7.11b

10 Clean the lifters with solvent and dry them thoroughly without mixing them up.

11 Check each lifter wall, pushrod seat and roller for scuffing, score marks and uneven wear. Check the rollers for wear and damage. Make sure the rollers turn freely without excessive play (see illustration). If the lifter walls are damaged or worn (which isn't very likely), inspect the lifter bores in the engine block as well. If the pushrod seats (see illustration) are worn, check the pushrod ends.

12 Used roller lifters can be reinstalled with a new camshaft if the lifters are in good condition. The original camshaft can be used if new lifters are installed, provided the cam lobes are in good condition.

Installation

Refer to illustration 7.16

13 The used lifters must be installed in their original bores. Coat them with moly-base grease or engine assembly lube.

14 Lubricate the bearing surfaces of the lifter bores with engine oil.

15 Install the lifter(s) in the lifter bore(s). **Note:** Make sure that the oil orifice is facing toward the front of the engine.

16 Install the lifter guide(s) and retainer(s) (see illustration).

17 Install the pushrods, pushrod guides, rocker arms and rocker arm retaining bolts (see Section 6). **Caution:** Make sure that each pair of lifters is on the base circle of the camshaft; that is, with both valves closed, before tightening the rocker arm bolts.

18 Tighten the rocker arm bolts to the torque listed in this Chapter's Specifications.

19 Install the pushrod cover (see Section 5).

20 Install the valve cover (see Section 3).

8 Intake manifold – removal and installation

Refer to illustrations 8.10 and 8.15

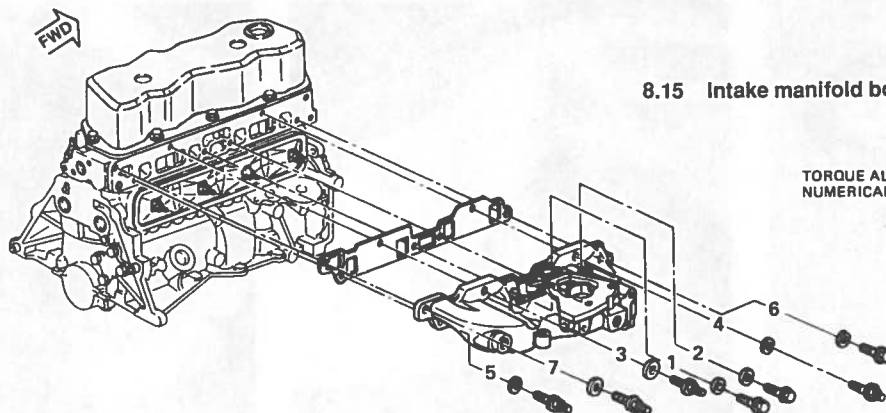
1 Disconnect the cable from the negative battery terminal.

2 Remove the air cleaner assembly (see Chapter 4).

3 Remove the PCV valve and hose.

4 Drain the cooling system (see Chapter 1).

5 Detach the fuel lines, vacuum lines and wire leads from the fuel injection assembly (see Chapter 4). When disconnecting the fuel line be pre-



8.15 Intake manifold bolt TIGHTENING sequence

pared to catch some fuel, then plug the line to prevent contamination.

6 After noting how it's installed, disconnect the fuel injection throttle linkage. Disconnect the cruise control and TVS linkage (if so equipped).

7 Tag and disconnect all remaining vacuum lines and wires hooked to components on the manifold. Remove the coolant hoses from the manifold.

8 Remove the ignition coil. Unbolt the alternator and bracket and set it aside (see Chapter 5).

9 Remove the mounting bolts and separate the manifold from the cylinder head. Don't pry between the manifold and head, as damage to the gasket sealing surfaces may result.

10 Remove the old gasket (see illustration).

11 If a new manifold is being installed, transfer all components still attached to the old manifold to the new one.

12 Before installing the manifold, clean the cylinder head and manifold gasket surfaces with lacquer thinner or acetone. All gasket material and sealing compound must be removed prior to installation.

13 Apply a thin coat of RTV sealant to the intake manifold and cylinder head mating surfaces. Make certain that the sealant will not spread into the air or coolant passages when the manifold is installed.

14 Place a new gasket on the manifold, hold the manifold in position against the cylinder head and install the mounting bolts finger tight.

15 Tighten the mounting bolts a little at a time in the correct sequence (see illustration) until they're all at the torque listed in this Chapter's Specifications.

16 Install the remaining components in the reverse order of removal.

17 Fill the radiator with coolant, start the engine and check for leaks.

9 Exhaust manifold - removal and installation

Refer to illustration 9.13

1 Remove the cable from the negative battery terminal.

2 Remove the air cleaner assembly (see Chapter 4).

3 Remove the heat stove pipe at the exhaust manifold.

4 Raise the vehicle and support it securely on jackstands.

5 Disconnect the oxygen sensor.

6 Label the four spark plug wires, then disconnect them and secure them out of the way.

7 Disconnect the exhaust pipe from the exhaust manifold. You may have to apply penetrating oil to the fastener threads, as they are usually corroded. The exhaust pipe can be hung from the frame with a piece of wire.

8 Remove the rear air conditioning compressor bracket.

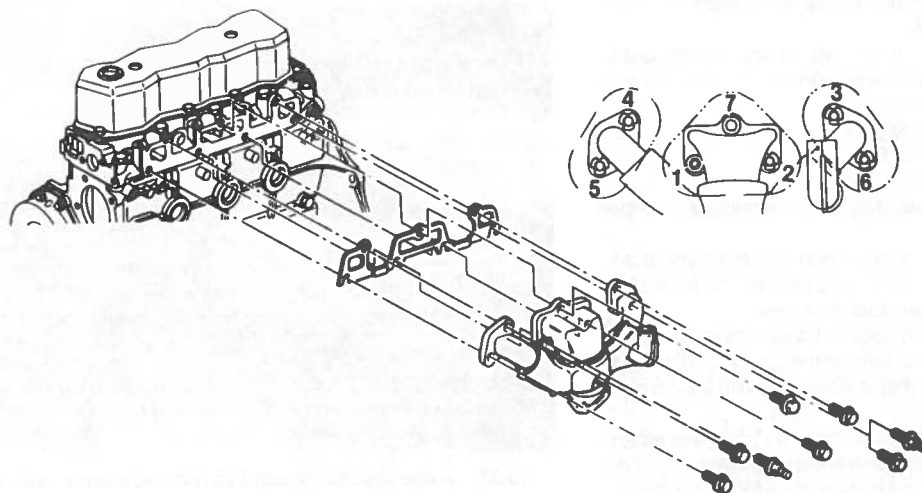
9 Remove the exhaust manifold end bolts first, then remove the center bolts and separate the exhaust manifold from the engine.

10 Remove the exhaust manifold gasket.

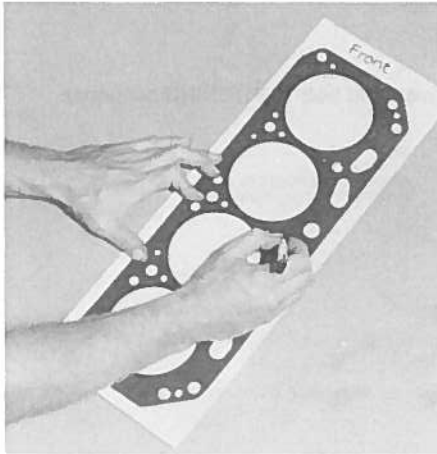
11 Before installing the manifold, clean the gasket mating surfaces on the cylinder head and manifold. All old gasket material and carbon deposits must be removed. Check the bolt threads for damage.

12 Place a new exhaust manifold gasket in position on the cylinder head, then place the manifold in position and install the mounting bolts finger tight.

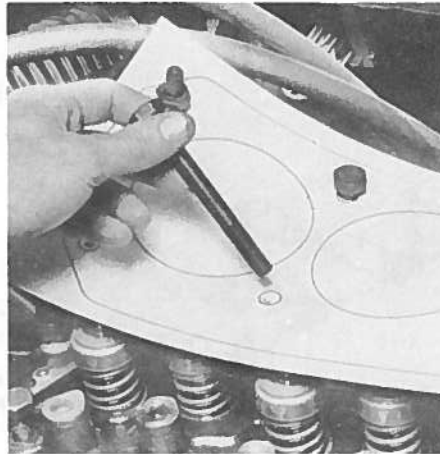
13 Tighten the mounting bolts a little at a time in the correct sequence (see illustration) until all of the bolts are at the torque listed in this Chapter's Specifications.



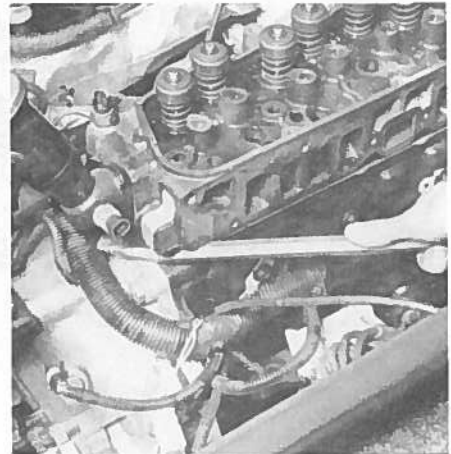
9.13 Exhaust manifold bolt TIGHTENING sequence



10.15 To avoid mixing up the head bolts, use a new gasket to transfer the bolt hole pattern to a piece of cardboard, then punch holes to accept the bolts . . .



10.16 . . . and push each head bolt through the matching hole in the cardboard



10.17 If the head is stuck, pry it up at the overhang just behind and below the thermostat housing

- 14 Reconnect the exhaust pipe and reinstall the air conditioning compressor bracket.
- 15 Lower the vehicle.
- 16 Install the remaining components in the reverse order of removal.
- 17 Start the engine and check for exhaust leaks between the manifold and cylinder head and between the manifold and exhaust pipe.

10 Cylinder head – removal and installation

Removal

Refer to illustrations 10.15, 10.16 and 10.17

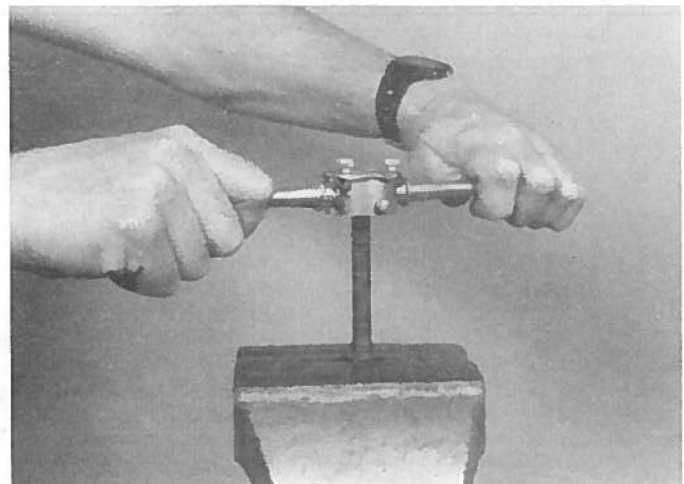
- 1 Disconnect the negative cable from the battery.
- 2 Drain the cooling system (see Chapter 1).
- 3 Remove the air cleaner assembly (see Chapter 4).
- 4 Remove the throttle, cruise control and Throttle Valve (TV) cables (as equipped).
- 5 Remove the dipstick tube and thermostat housing.
- 6 Remove the alternator and brackets (see Chapter 5).
- 7 Unbolt the air conditioner compressor and swing it out of the way for clearance. **Caution:** Don't disconnect any of the air conditioning lines unless the system has been depressurized by a dealer service department or other repair shop.
- 8 Disconnect all wires and vacuum hoses from the cylinder head and manifold. Be sure to label them to simplify reinstallation. Detach the fuel lines from the TBI unit (see Chapter 4).
- 9 Remove the upper radiator, water pump bypass and heater hoses.
- 10 Disconnect the spark plug wires and remove the spark plugs. Be sure to label the plug wires to simplify reinstallation.
- 11 Remove the valve cover (see Section 3).
- 12 Remove the pushrods (see Section 6).
- 13 Remove the ignition coil (see Chapter 5).
- 14 Raise the vehicle and support it securely on jackstands, then unbolt the exhaust pipe from the manifold.
- 15 Using a new head gasket, outline the cylinders and bolt pattern on a piece of cardboard (see illustration). Be sure to indicate the front of the engine for reference. Punch holes at the bolt locations.
- 16 Loosen the cylinder head mounting bolts in 1/4-turn increments until they can be removed by hand. Store the bolts in the cardboard holder as they're removed – this will ensure that they are reinstalled in their original locations (see illustration).
- 17 Lift the head off the engine. If it's stuck, pry on it only at the overhang on the thermostat end of the head (see illustration). **Caution:** If you pry on the head anywhere else, damage to the gasket surface may result.
- 18 Place the head on a block of wood to prevent damage to the gasket

surface. See Part F for cylinder head disassembly and valve service procedures.

Installation

Refer to illustrations 10.19, 10.23, 10.25 and 10.28

- 19 If a new cylinder head is being installed, transfer all external parts from the old cylinder head to the new one (see illustration).
- 20 The mating surfaces of the cylinder head and block must be perfectly clean when the head is installed. It's also a good idea to have the head checked for distortion (warpage) and cracks by an automotive machine shop.
- 21 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's oil on the mating surfaces when the head is installed, the gasket may not seal correctly and leaks may develop. Use a vacuum cleaner to remove any debris that falls into the cylinders.
- 22 Check the block and head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with a file; if it's excessive, machining may be the only alternative.
- 23 Use a tap of the correct size to chase the threads in the head bolt holes. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads (see illustration). Dirt, corrosion, sealant and damaged threads will affect critical head bolt torque readings.

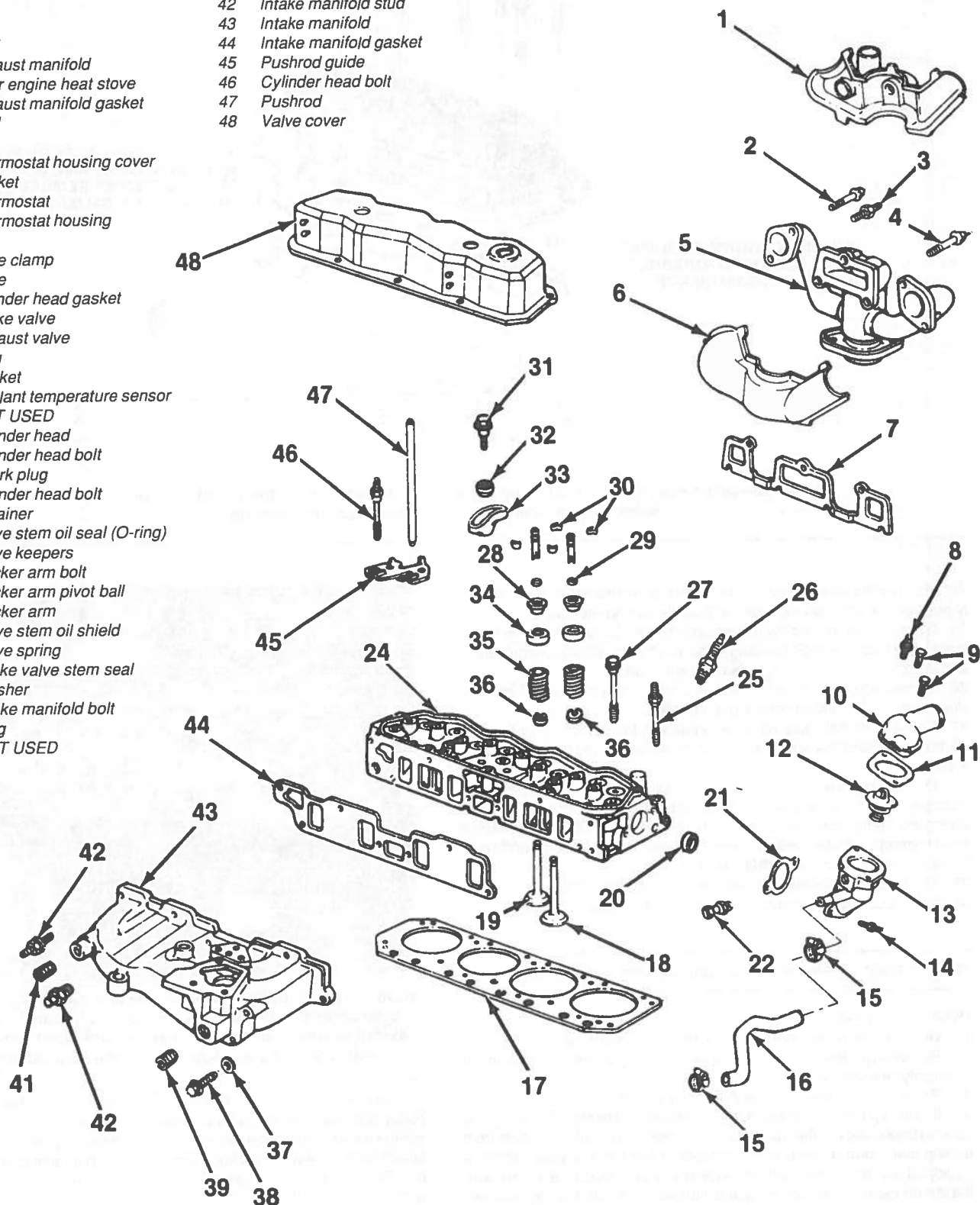


10.23 A die should be used to remove sealant and corrosion from the head bolt threads prior to installation

10.19 Cylinder head and related components – exploded view

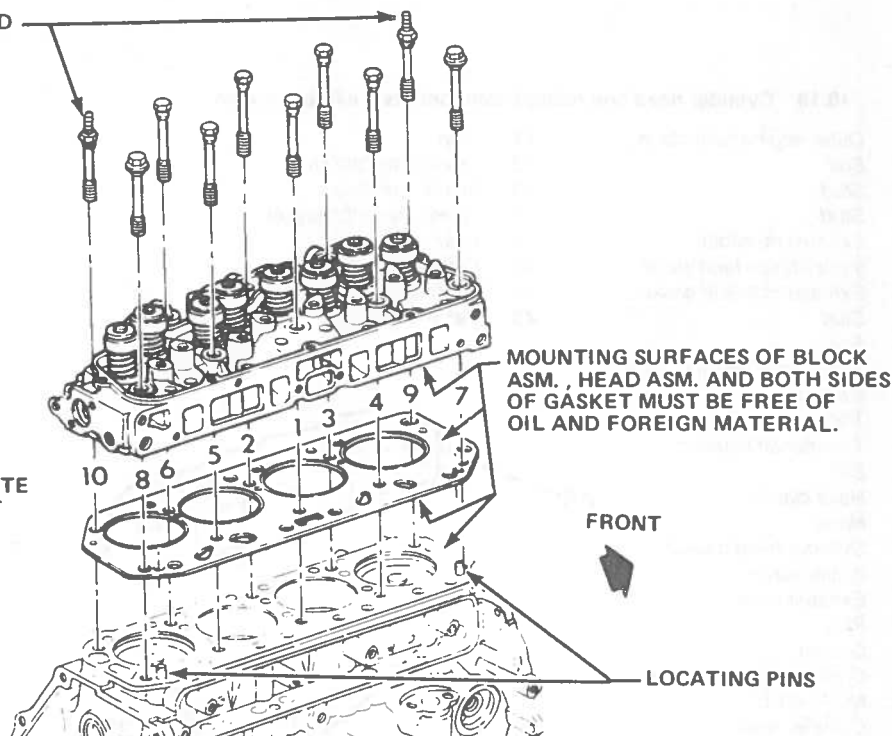
- 1 Outer engine heat stove
- 2 Bolt
- 3 Stud
- 4 Stud
- 5 Exhaust manifold
- 6 Inner engine heat stove
- 7 Exhaust manifold gasket
- 8 Stud
- 9 Bolt
- 10 Thermostat housing cover
- 11 Gasket
- 12 Thermostat
- 13 Thermostat housing
- 14 Bolt
- 15 Hose clamp
- 16 Hose
- 17 Cylinder head gasket
- 18 Intake valve
- 19 Exhaust valve
- 20 Plug
- 21 Gasket
- 22 Coolant temperature sensor
- 23 NOT USED
- 24 Cylinder head
- 25 Cylinder head bolt
- 26 Spark plug
- 27 Cylinder head bolt
- 28 Retainer
- 29 Valve stem oil seal (O-ring)
- 30 Valve keepers
- 31 Rocker arm bolt
- 32 Rocker arm pivot ball
- 33 Rocker arm
- 34 Valve stem oil shield
- 35 Valve spring
- 36 Intake valve stem seal
- 37 Washer
- 38 Intake manifold bolt
- 39 Plug
- 40 NOT USED

- 41 Plug
- 42 Intake manifold stud
- 43 Intake manifold
- 44 Intake manifold gasket
- 45 Pushrod guide
- 46 Cylinder head bolt
- 47 Pushrod
- 48 Valve cover



APPLY SEALING COMPOUND
PART NUMBER 1052080 OR
EQUIVALENT TO THREADS
ON BOLTS SHOWN.

NUMBERS SHOWN DESIGNATE
BOLT POSITIONS AND BOLT
TIGHTENING SEQUENCE.



10.25 The cylinder head bolts must be tightened in three stages to the torque listed in this Chapter's Specifications, using the numerical sequence shown here

24 Position the new gasket over the dowel pins in the block, then carefully position the head on the block without disturbing the gasket.

25 Coat the threads and the undersides of the heads of cylinder head bolt numbers 9 and 10 with GM sealing compound (no. 1052080 or equivalent) and install the bolts finger tight (*see illustration*).

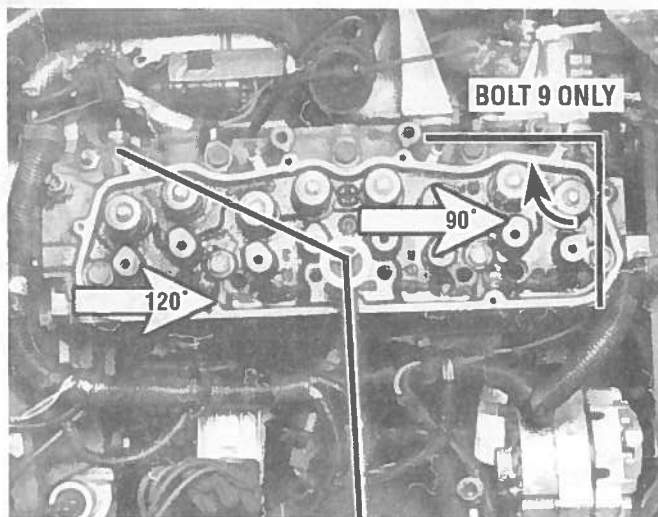
26 Tighten each of the bolts a little at a time in the sequence shown in illustration 10.25 until all bolts are at 18 ft-lbs.

27 On 1985 models only, continue tightening the bolts, in sequence, to 40, then to 70 and finally to 92 ft-lbs. On 1986 models the final torque is 90 ft-lbs.

28 On 1987 and later models, tighten all bolts EXCEPT the left front bolt (number 9 in the sequence) to 22 ft-lbs. Tighten number 9 to 30 ft-lbs. Following the sequence one more time, tighten all bolts EXCEPT number 9 an additional 120-degrees (1/3-turn). Tighten number 9 an additional 90-degrees (1/4-turn) (*see illustration*).

29 The remaining installation steps are the reverse of removal.

30 Change the oil and filter, run the engine and check for leaks.



10.28 On 1987 and later models, the final step in tightening the cylinder head bolts is known as "angle torquing" – all bolts except number 9 should be turned an additional 120-degrees, while bolt 9 should be turned an additional 90-degrees

11 Crankshaft pulley and hub – removal and installation

Refer to illustrations 11.6 and 11.9

1 Remove the cable from the negative battery terminal.

2 Remove the drivebelts (see Chapter 1). Tag each belt as it's removed to simplify reinstallation.

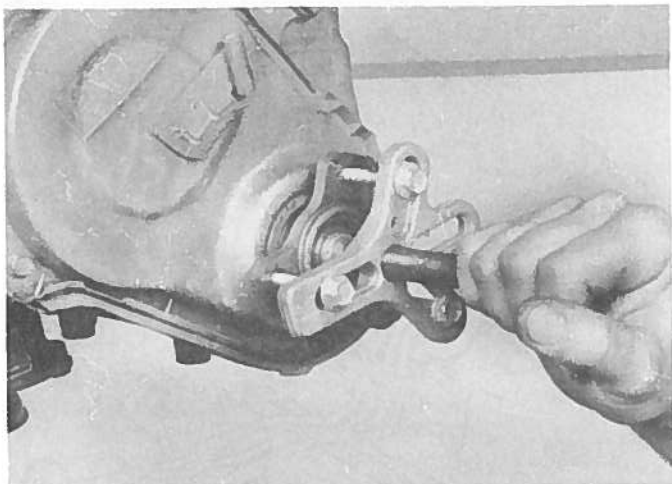
3 Raise the vehicle and place it securely on jackstands.

4 If your vehicle is equipped with a manual transmission, apply the parking brake and put the transmission in gear to prevent the engine from turning over, then remove the crankshaft pulley bolts. If your vehicle is equipped with an automatic transmission, it may be necessary to remove the starter motor (see Chapter 5) and immobilize the starter ring gear with a large screwdriver while an assistant loosens the pulley bolts.

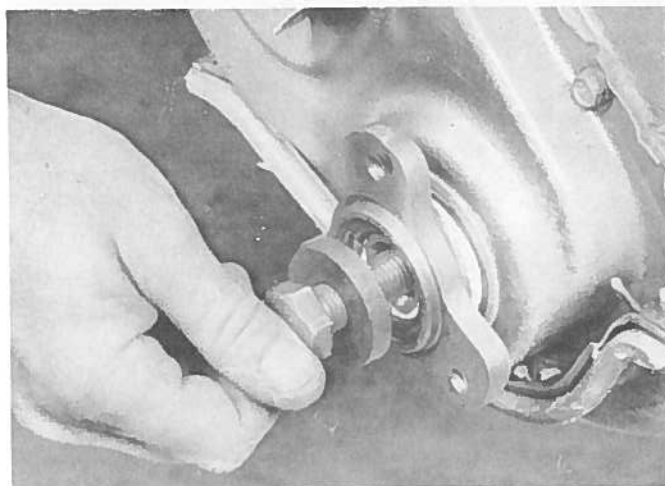
5 To loosen the crankshaft hub retaining bolt, install a bolt in one of the pulley bolt holes. Attach a breaker bar, extension and socket to the hub retaining bolt and immobilize the hub by wedging a large screwdriver between the bolt and the socket. Remove the hub retaining bolt.

6 Remove the crankshaft hub. Use a puller if necessary (*see illustration*).

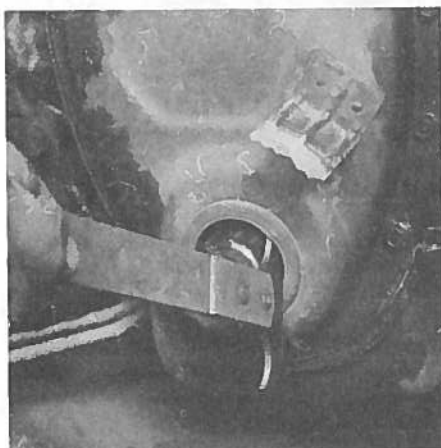
7 Replace the front oil seal, if necessary (see Section 12).



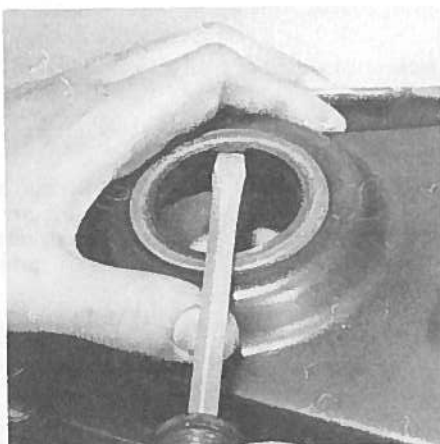
11.6 Use a puller to remove the hub from the crankshaft



11.9 Use the pulley hub bolt to press the hub onto the crankshaft



12.2 The front crankshaft seal can be removed in the vehicle with a seal removal tool or a large screwdriver (V6 engine shown – four-cylinder similar)



12.6 Once the timing gear cover is removed, place it on a flat surface and gently pry the old seal out with a large screwdriver



12.8a Clean the bore, then apply a small amount of oil to the outer edge of the new seal and drive it squarely into the opening with a large socket . . .

- 8 Apply a thin layer of moly-base grease to the seal contact surface of the hub.
- 9 Slide the pulley hub onto the crankshaft until it bottoms against the crankshaft timing gear. Note that the slot in the hub must be aligned with the Woodruff key in the end of the crankshaft. The hub retaining bolt can also be used to press the hub into position (see illustration).
- 10 Tighten the hub-to-crankshaft bolt to the torque listed in this Chapter's Specifications.
- 11 Install the crankshaft pulley on the hub. Use Loctite on the bolt threads.
- 12 Install the drivebelts (see Chapter 1).

12 Crankshaft front oil seal – replacement

Note: The front seal can be replaced with the timing gear cover in place. However, due to the limited amount of room available, you may conclude that the procedure would be easier if the cover were removed from the engine first. If so, see Section 14 for the cover removal and installation procedure.

Timing gear cover in place

Refer to illustration 12.2

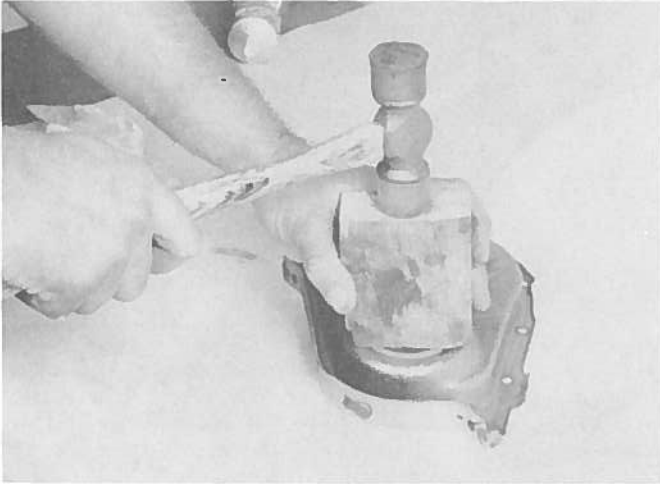
- 1 Disconnect the negative battery cable from the battery, then remove the crankshaft pulley hub (see Section 11).

- 2 Note how the seal is installed – the new one must face the same direction! Carefully pry the oil seal out of the cover with a seal puller or a large screwdriver (see illustration). Be very careful not to distort the cover or scratch the crankshaft!
- 3 Apply clean engine oil or multi-purpose grease to the outer edge of the new seal, then install it in the cover with the lip (open end) facing IN. Drive the seal into place with a large socket and a hammer (if a large socket isn't available, a piece of pipe will also work). Make sure the seal enters the bore squarely and stop when the front face is flush with the cover.
- 4 Install the pulley hub (see Section 11).

Timing gear cover removed

Refer to illustrations 12.6, 12.8a and 12.8b

- 5 Remove the timing gear cover (see Section 14).
- 6 Using a large screwdriver, pry the old seal out of the cover (see illustration). Be careful not to distort the cover or scratch the wall of the seal bore. If the engine has accumulated a lot of miles, apply penetrating oil to the seal-to-cover joint and allow it to soak in before attempting to remove the seal.
- 7 Clean the bore to remove any old seal material and corrosion. Support the cover on a block of wood and position the new seal in the bore with the lip (open end) of the seal facing IN. A small amount of oil applied to the outer edge of the new seal will make installation easier – don't overdo it!
- 8 Drive the seal into the bore with a large socket and hammer until it's completely seated (see illustration). Select a socket that's the same out-



12.8b ... or block of wood and a hammer – don't damage the seal in the process!

side diameter as the seal. A section of pipe or even a block of wood can be used if a socket isn't available) (see illustration).

9 Reinstall the timing gear cover.

13 Top Dead Center (TDC) for number 1 piston – locating

Refer to illustrations 13.4 and 13.5

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke. The timing marks on the pulley installed on the front of the crankshaft are referenced to the number one piston at TDC on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as rocker arm removal, camshaft and timing gear removal and distributor removal.

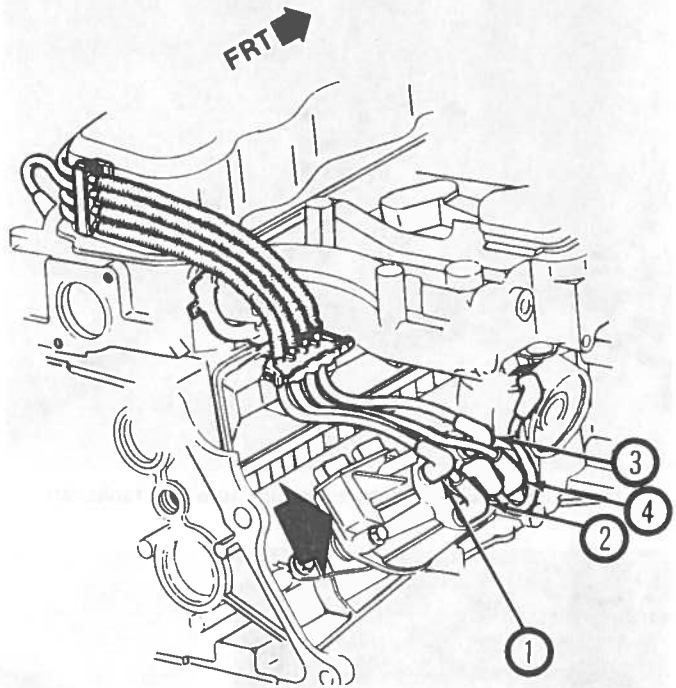
3 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise. **Warning:** Before beginning this procedure, be sure to place the transmission in Neutral and unplug the distributor wire harness connector to disable the ignition system.

- a) The preferred method is to turn the crankshaft with a large socket and breaker bar attached to the crankshaft pulley hub bolt threaded into the front of the crankshaft.
- b) A remote starter switch, which may save some time, can also be used. Attach the switch leads to the S (switch) and B (battery) terminals on the starter motor. Once the piston is close to TDC, use a socket and breaker bar (see previous paragraph).
- c) If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Use a socket and breaker bar (see Paragraph a) to complete the procedure.

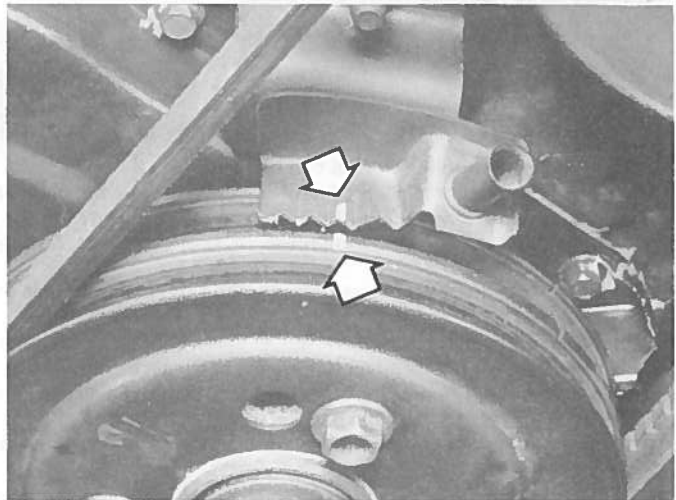
4 Note the position of the terminal for the number one spark plug wire on the distributor cap (see illustration). Use a felt-tip pen or chalk to make a mark on the distributor body directly under the terminal. Remove the screws, detach the cap from the distributor and set it aside.

5 Turn the crankshaft (see Paragraph 3 above) until the notch in the crankshaft pulley is aligned with the 0 on the timing plate (located at the front of the engine) (see illustration).

6 Look at the distributor rotor – it should be pointing directly at the mark you made on the distributor body. If the rotor is pointing at the terminal for the number four spark plug, the number one piston is at TDC on the exhaust stroke.



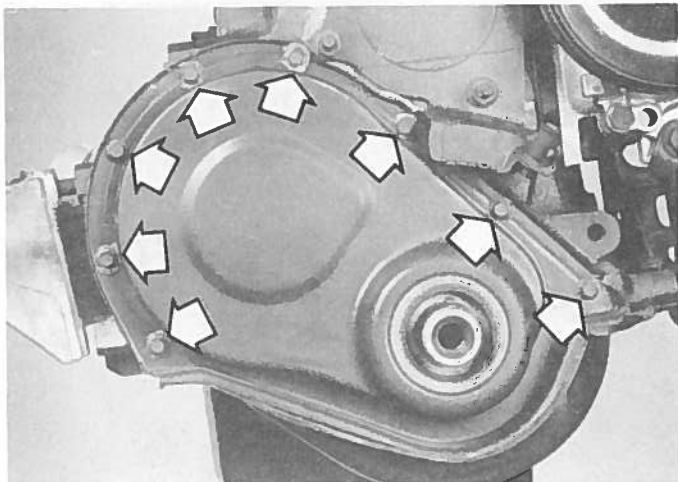
13.4 After you locate the number 1 spark plug wire terminal on the distributor cap, make a mark (arrow) on the distributor body directly under the terminal (2.5L engine shown, but the principle applies to other engines)



13.5 Turn the crankshaft until the notch in the drivebelt pulley (lower arrow) is directly opposite the zero mark on the timing plate (upper arrow) (note that in this illustration, the crankshaft must be turned just a little more to align the marks)

7 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360-degrees) clockwise. The rotor should now be pointing at the mark on the distributor. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap and the ignition timing marks are aligned, the number one piston is at TDC on the compression stroke.

8 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft 180-degrees at a time and following the firing order (1-3-4-2).

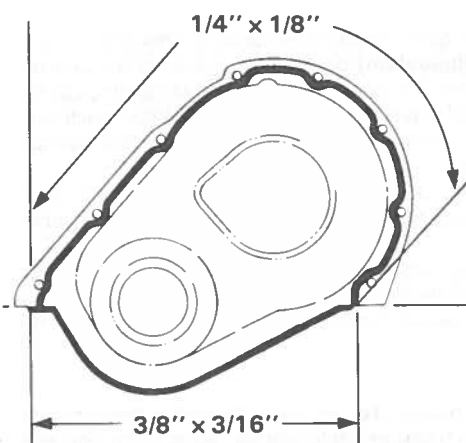


14.9 Timing gear cover bolt locations

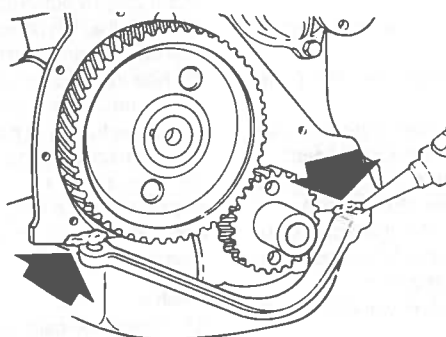
14 Timing gear cover – removal and installation

Refer to illustrations 14.9, 14.13 and 14.14

- 1 Detach the cable from the negative terminal of the battery.
- 2 Remove the power steering reservoir (if equipped). Be prepared to catch the fluid in a drain pan.
- 3 Remove the upper fan shroud (see Chapter 3).
- 4 Remove the drivebelts (see Chapter 1).
- 5 Detach the fan and drivebelt pulley.
- 6 Disconnect and unbolt the alternator and brackets (see Chapter 5).
- 7 Raise the front of the vehicle and support it on jackstands. Apply the parking brake. Drain the coolant (see Chapter 1), then detach the lower radiator hose from the water pump.
- 8 Remove the crankshaft pulley and hub (see Section 11).
- 9 Remove the timing gear cover-to-block bolts (see illustration).
- 10 Remove the cover by carefully prying it off. The cover is sealed with RTV, so it may be stuck to the block. The flange between the cover and oil pan may be bent during removal. Try to minimize damage to the flange or it may be too distorted to be straightened.
- 11 Use a scraper to remove all old sealant from the cover, oil pan and block, then clean the mating surfaces with lacquer thinner or acetone.



14.13 Apply a 1/4-inch wide by 1/8-inch thick bead of RTV sealant to the timing gear cover flange that contacts the block and a 3/8-inch wide by 3/16-inch thick bead to the cover-to-oil pan flange



14.14 Put a dab of sealant at the junction between the oil pan and the bottom edge of the block (arrows)

12 Check the cover flanges for distortion, particularly around the bolt holes. If necessary, place the cover on a block of wood and use a hammer to flatten and restore the mating surfaces.

13 Apply a 3/8-inch wide by 3/16-inch thick bead of RTV sealant to the timing gear cover flange that mates with the oil pan. Apply a 1/4-inch wide by 1/8-inch thick bead to the cover-to-block flange (see illustration).

14 Apply a dab of sealant to the joints between the oil pan and the engine block (see illustration).

15 Place the cover in position and loosely install a couple of mounting bolts.

16 Install the crankshaft hub to center the cover (see Section 11). Be sure to lubricate the seal contact surface of the hub.

17 Install the remaining mounting bolts and tighten them to the torque listed in this Chapter's Specifications.

18 Install the crankshaft pulley, then hook up the lower radiator hose.

19 Lower the vehicle.

20 Refill the cooling system (see Chapter 1).

21 Install the components removed to gain access to the cover.

22 Reattach the cable to the negative terminal of the battery.

23 Start the engine and check for oil leaks at the seal.

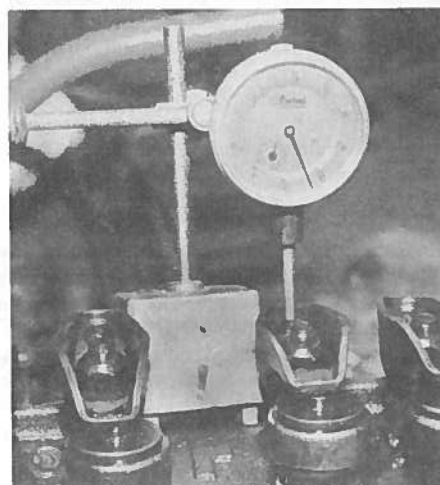
15 Camshaft, timing gears and bearings – removal, inspection and installation

2C

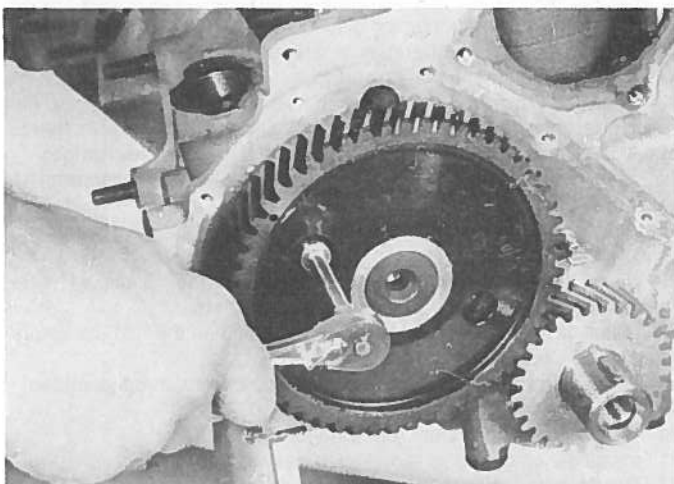
Camshaft lobe lift check

Refer to illustration 15.3

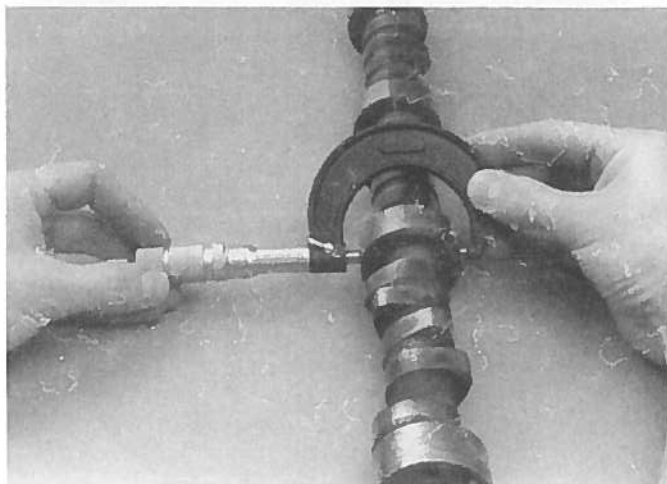
- 1 In order to determine the extent of cam lobe wear, the lobe lift should be checked prior to camshaft removal. Remove the valve cover (see Section 3).
- 2 Position the number one piston at TDC on the compression stroke (see Section 13).
- 3 Beginning with the number one cylinder valves, mount a dial indicator on the engine and position the plunger against the top surface of the first rocker arm. The plunger should be directly above and in line with the pushrod (see illustration).
- 4 Zero the dial indicator, then very slowly turn the crankshaft in the normal direction of rotation (clockwise when looking at the front of the engine) until the indicator needle stops and begins to move in the opposite direction. The point at which it stops indicates maximum cam lobe lift.
- 5 Record this figure for future reference, then reposition the piston at TDC on the compression stroke.



15.3 When checking the camshaft lobe lift, the dial indicator plunger must be positioned directly above and in line with the pushrod



15.24 Turn the camshaft until the holes in the gear are aligned with the thrust plate bolts, then remove them with a ratchet and socket



15.28 The camshaft bearing journal diameters are checked to pinpoint excessive wear and out-of-round conditions

- 6 Move the dial indicator to the remaining number one cylinder rocker arm and repeat the check. Be sure to record the results for each valve.
- 7 Repeat the check for the remaining valves. Since each piston must be at TDC on the compression stroke for this procedure, work from cylinder-to-cylinder following the firing order sequence. Turn the crankshaft 180-degrees when moving from one cylinder to the next.
- 8 After the check is complete, compare the results to the Specifications. If camshaft lobe lift is less than specified, cam lobe wear has occurred and a new camshaft should be installed.

Removal

Refer to illustration 15.24

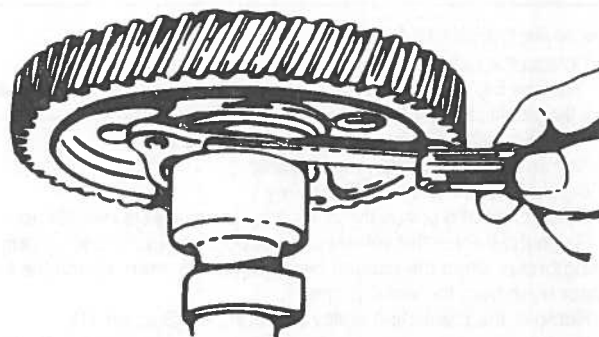
- 9 Disconnect the negative battery cable from the battery.
- 10 Place a drain pan under the power steering reservoir.
- 11 Detach the power steering reservoir from the fan shroud and drain the fluid.
- 12 Remove the radiator (see Chapter 3).
- 13 Remove the drivebelts (see Chapter 1).
- 14 Detach the fan and drivebelt pulley (see Chapter 3).
- 15 Remove the air cleaner assembly.
- 16 Remove the pushrod cover (see Section 5).
- 17 Remove the EGR valve (see Chapter 6).
- 18 Tag and disconnect the vacuum hoses at the intake manifold and thermostat housing.
- 19 Remove the pushrods and lifters.
- 20 Detach the timing gear cover (see Section 14).
- 21 Remove the distributor (see Chapter 5) and the oil pump driveshaft (see Section 16).
- 22 Remove the headlight bezels, the grille and the bumper filler panel (see Chapter 11).
- 23 Remove the air conditioning condenser baffles. Unbolt the condenser and support it out of the way — don't disconnect the refrigerant lines!
- 24 Turn the crankshaft until the holes in the camshaft gear are aligned with the thrust plate bolts, then remove the bolts (see illustration).
- 25 Carefully pull the camshaft and gear assembly out of the block. **Caution:** To avoid damage to the camshaft bearings as the lobes pass over them, support the camshaft near the block as it's withdrawn.
- 26 The crankshaft gear should slide off the crankshaft without a great deal of resistance.

Inspection

Refer to illustrations 15.28 and 15.32

Camshaft

- 27 After the camshaft has been removed from the engine, cleaned with solvent and dried, inspect the bearing journals for uneven wear, pitting and



15.32 Use a feeler gauge to check the thrust plate (gear) end clearance

evidence of seizure. If the journals are damaged, the bearing inserts in the block are probably damaged as well. Both the camshaft and bearings will have to be replaced.

28 If the journals are in good condition, measure the bearing journals with a micrometer (see illustration) to determine their sizes and whether or not they're out-of-round. The inside diameter of each bearing can be measured with a telescoping gauge and micrometer. Subtract each cam journal diameter from the corresponding bearing inside diameter to obtain the bearing oil clearance.

29 Compare the clearance for each bearing to the Specifications. If it's excessive for any of the bearings, have new bearings installed by an automotive machine shop.

30 Check the camshaft lobes for heat discoloration, score marks, chipped areas, pitting and uneven wear. If the lobes are in good condition and if the lobe lift measurements are as specified, the camshaft can be reused.

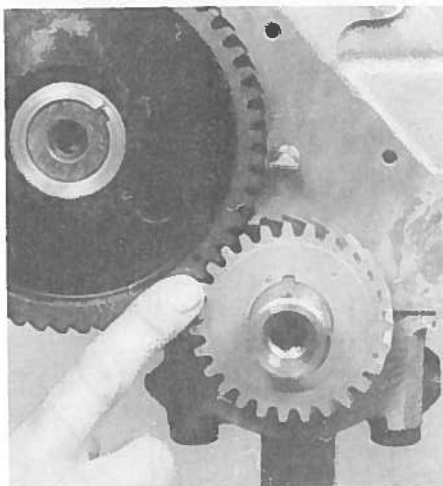
Gears

31 Check the camshaft drive and driven gears for cracks, missing teeth and excessive wear. If the teeth are highly polished, pitted and galled, or if the outer hardened surface of the teeth is flaking off, new parts will be required. If one gear is worn or damaged, replace both gears as a set. Never install one new and one used gear.

32 Check the gear end clearance with a feeler gauge and compare it to the Specifications (see illustration). If it's less than the minimum specified, the spacer ring should be replaced. If it's excessive, the thrust plate



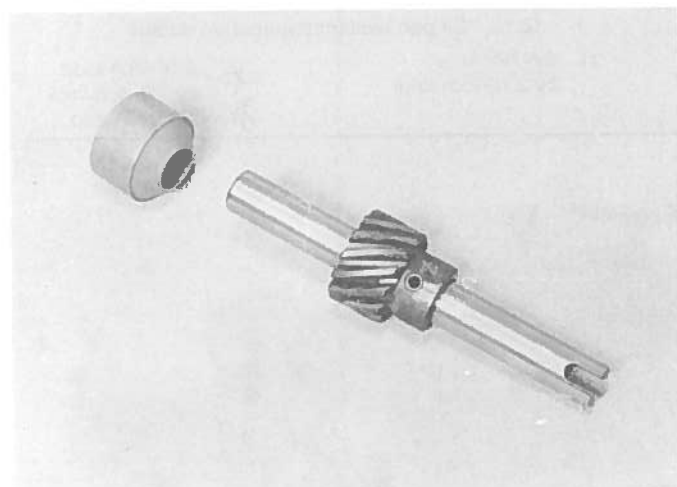
15.34 Be sure to prelube the bearing journals and lobes prior to camshaft installation



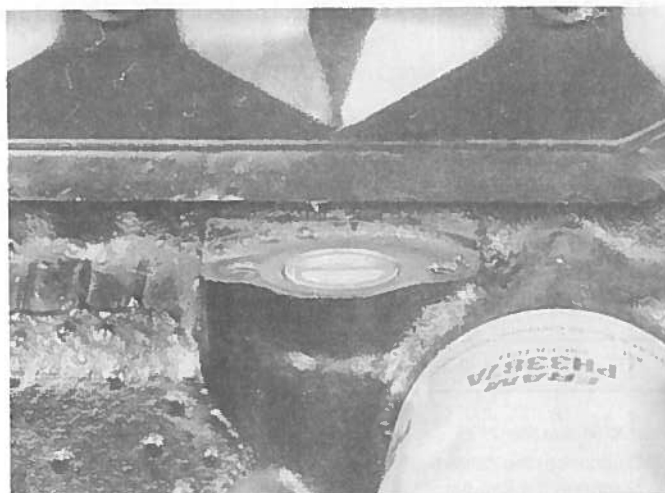
15.36 Align the timing marks as shown here when installing the camshaft



16.3 The oil pump driveshaft retainer plate is located on the engine block, just below the pushrod cover and just above the oil filter



16.6 Inspect the oil pump driveshaft, gear and bushing for wear and damage



16.7 If the slotted oil pump driveshaft is properly mated with the oil pump gear tang, the top of the bushing will be flush with the retainer plate mounting surface

must be replaced. In either case, the gear will have to be pressed off the camshaft, so take the parts to an automotive machine shop.

Bearing replacement

33 Camshaft bearing replacement requires special tools and expertise that place it outside the scope of the home mechanic. Take the block to an automotive machine shop to ensure that the job is done correctly.

Installation

Refer to illustrations 15.34 and 15.36

34 Lubricate the camshaft bearing journals and cam lobes with moly-base grease, engine assembly lube or GM camshaft and lifter prelube (*see illustration*).

35 Slide the camshaft into the engine. Support the cam near the block and be careful not to scrape or nick the bearings.

36 Install the gear on the end of the crankshaft (if not already done). Don't forget the Woodruff key and don't hammer the gear onto the shaft. Align the timing marks on the gears as the gears mesh (*see illustration*).

37 Line up the access holes in the gear with the thrust plate holes and the bolt holes in the block. Apply Locktite to the threads, then install the thrust

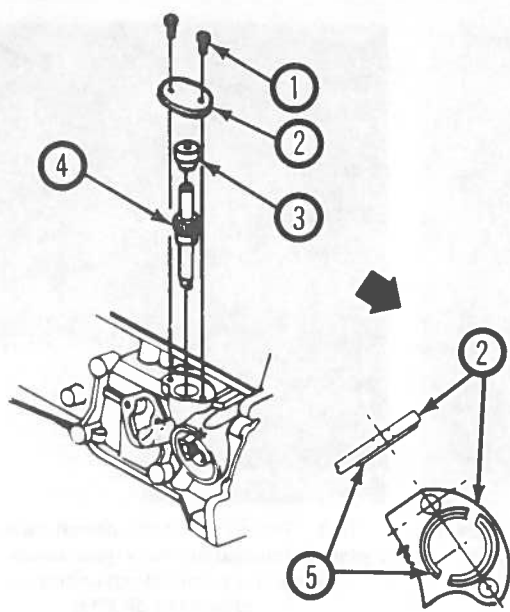
plate bolts and tighten them to the torque listed in this Chapter's Specifications.

38 The remaining installation steps are the reverse of removal.

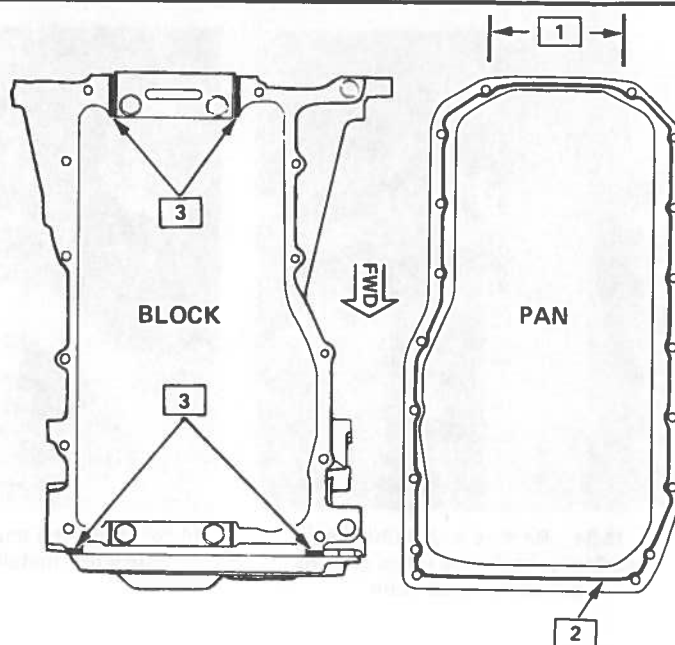
16 Oil pump driveshaft - removal and installation

Refer to illustrations 16.3, 16.6, 16.7 and 16.8

- 1** Disconnect the cable from the negative terminal of the battery.
- 2** Raise the vehicle and support it on jackstands.
- 3** Remove the oil pump driveshaft retainer plate bolts (*see illustration*).
- 4** Remove the oil pump driveshaft and bushing with a magnet.
- 5** Clean the mating surfaces of the block and retainer plate with lacquer thinner or acetone.
- 6** Check the bushing and driveshaft for wear (*see illustration*). Replace them if they're worn or damaged.
- 7** Install the bushing and oil pump driveshaft in the block. The shaft driven gear must mesh with the camshaft drive gear and the slot in the lower end of the shaft must mate with the oil pump gear tang (*see illustration*).

**16.8 Oil pump driveshaft and related components – exploded view**

- | | |
|------------------|--------------------------------|
| 1 Bolts | 4 Driveshaft and gear assembly |
| 2 Retainer plate | 5 RTV sealant |
| 3 Bushing | |

**17.11 Oil pan sealant application details**

- | | |
|---------------------------------------|---------------------------------------|
| 1 3/8-inch wide
by 3/16-inch thick | 2 3/16-inch wide
by 1/8-inch thick |
| | 3 1/8-inch bead |

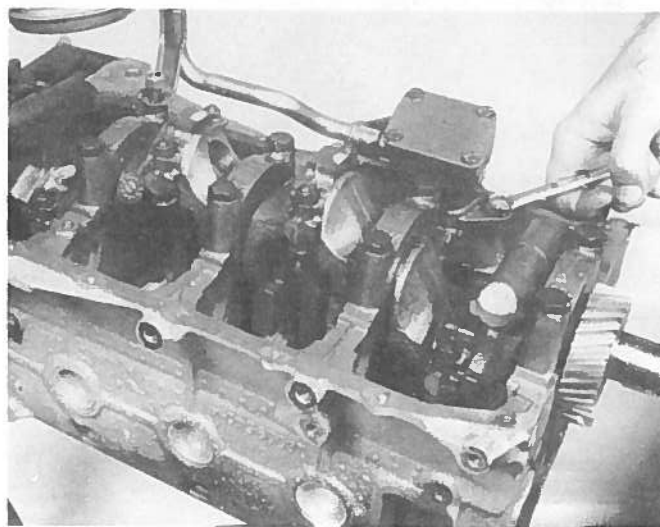
8 Apply a 1/16-inch bead of RTV sealant to the retainer plate so it completely seals around the oil pump driveshaft hole in the block (see illustration).

9 Install the retainer plate and tighten the mounting bolts securely.

17 Oil pan – removal and installation

Refer to illustration 17.8

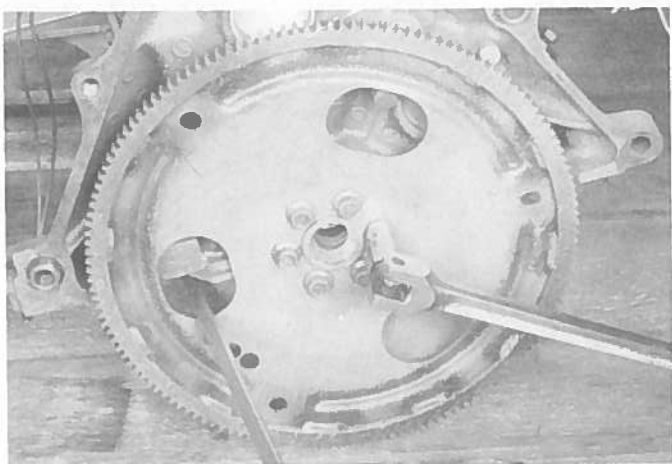
- 1 Disconnect the cable from the negative battery terminal.
- 2 Disconnect the radiator fan shroud.
- 3 Raise the vehicle and support it securely on jackstands.
- 4 Drain the engine oil and remove the oil filter (see Chapter 1).
- 5 Remove the engine strut rods.
- 6 Disconnect the exhaust pipe at the manifold and remove the catalytic converter and exhaust pipe.
- 7 Remove the starter (see Chapter 5) and the bellhousing dust cover.
- 8 Remove the engine mount through bolts. Raise the engine with a jack and block it up in a safe position.
- 9 Remove the bolts and detach the oil pan. Don't pry between the block and pan or damage to the sealing surfaces may result and oil leaks could develop. If the pan is stuck, dislodge it with a block of wood and a hammer.
- 10 Use a scraper to remove all traces of sealant from the pan and block, then clean the mating surfaces with lacquer thinner or acetone.
- 11 Apply a 3/16-inch wide by 1/8-inch thick bead of RTV sealant to the oil pan flange. Make the bead 3/8-inch wide by 3/16-inch thick between the bolt holes at the rear end of the pan. Apply a 1/8-inch bead of sealant to the block at the rear main bearing cap joints and the timing gear cover joints (see illustration).
- 12 Install the oil pan and tighten the mounting bolts to the torque listed in this Chapter's Specifications. Start at the center of the pan and work out toward the ends in a spiral pattern.
- 13 The remainder of installation is reverse of removal.
- 14 Lower the vehicle.
- 15 Install a new filter and add oil to the engine.
- 16 Reconnect the negative battery cable.
- 17 Start the engine and check for leaks.

**18.2 Remove the oil pump flange mounting bolts and the pick-up tube bracket nut**

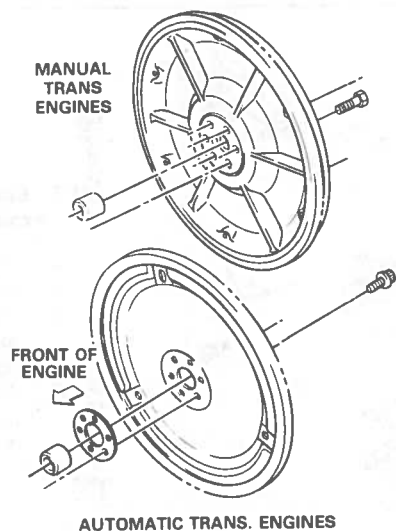
18 Oil pump – removal and installation

Refer to illustration 18.2

- 1 Remove the oil pan (see Section 17).
- 2 Remove the two oil pump mounting bolts and the pick-up tube bracket nut from the main bearing cap bolt (see illustration).
- 3 Detach the oil pump and pick-up assembly from the block.
- 4 If the pump is defective, replace it with a new one. If the engine is being completely overhauled, install a new oil pump – don't reuse the original or attempt to rebuild it.



19.2 A large screwdriver wedged in the starter ring gear teeth or one of the holes in the driveplate can be used to keep the flywheel/driveplate from turning as the mounting bolts are removed



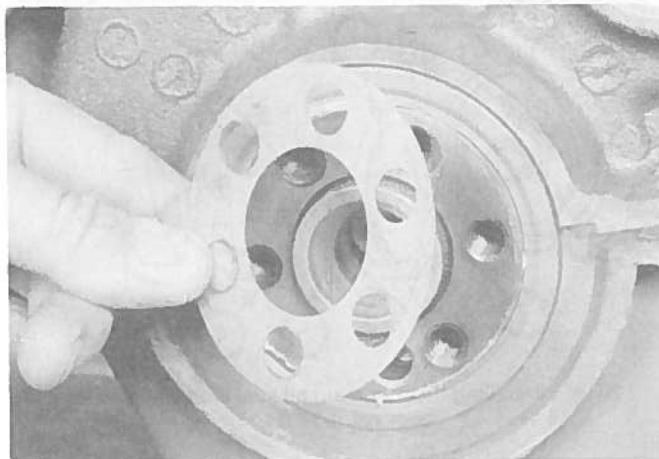
19.3b Flywheel/driveplate mounting details

- 5 To install the pump, turn the shaft so the gear tang mates with the slot on the lower end of the oil pump driveshaft. The oil pump should slide easily into place over the oil pump driveshaft lower bushing. If it doesn't, pull it off and turn the tang until it's aligned with the pump driveshaft slot.
- 6 Install the pump mounting bolts and the tube bracket nut. Tighten them to the torque listed in this Chapter's Specifications.
- 7 Reinstall the oil pan (see Section 17).
- 8 Add oil, run the engine and check for leaks.

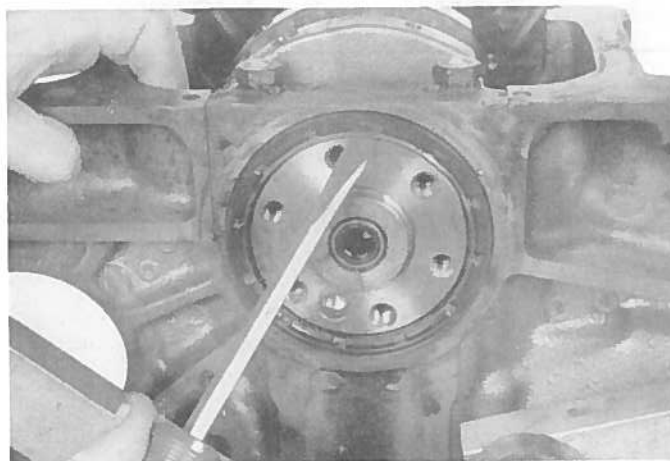
19 Flywheel/driveplate – removal and installation

Refer to illustrations 19.2, 19.3a and 19.3b

- 1 Remove the transmission (see Chapter 7). If your vehicle has a manual transmission, the pressure plate and clutch will also have to be removed (see Chapter 8).
- 2 Jam a large screwdriver in the starter ring gear or driveplate hole to keep the crankshaft from turning, then remove the mounting bolts (see illustration). Since it's fairly heavy, support the flywheel as the last bolt is removed.
- 3 Pull straight back on the flywheel/driveplate to detach it from the crankshaft. Note the shim installed between the driveplate and crankshaft on vehicles equipped with an automatic transmission (see illustrations).



19.3a Don't lose the shim used on automatic transmission equipped vehicles



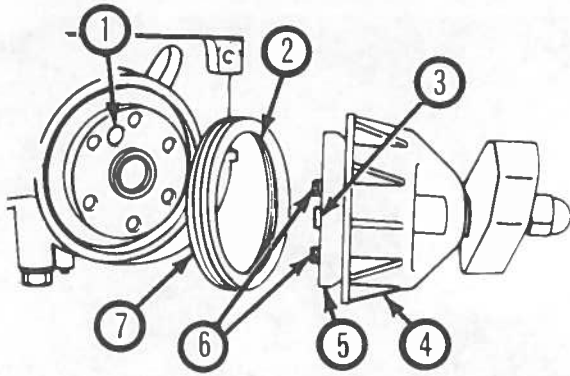
20.5 Carefully pry the oil seal out with a screwdriver – don't nick or scratch the crankshaft or the new seal will be damaged and leaks will develop

- 4 On manual transmission equipped vehicles, check the pilot bushing and replace it if necessary (see Chapter 8).
- 5 Installation is the reverse of removal. Be sure to align the hole in the flywheel/driveplate with the dowel pin in the crankshaft. Use Locktite on the bolt threads and tighten them to the torque listed in this Chapter's Specifications in a criss-cross pattern.

20 Rear main oil seal – replacement

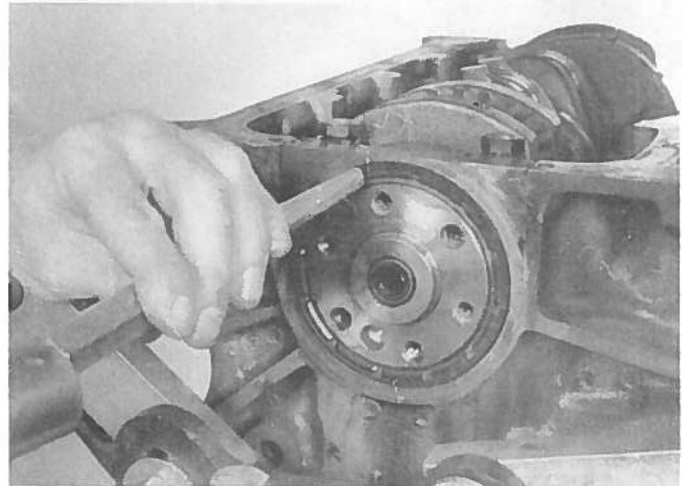
Refer to illustrations 20.5, 20.8a and 20.8b

- 1 The rear main bearing oil seal can be replaced without removing the oil pan or crankshaft.
- 2 Remove the transmission (see Chapter 7).
- 3 If equipped with a manual transmission, remove the pressure plate and clutch disc (see Chapter 8).
- 4 Remove the flywheel or driveplate (see Section 19).
- 5 Using a seal removal tool or a large screwdriver, carefully pry the seal out of the block (see illustration). Don't scratch or nick the crankshaft in the process.
- 6 Clean the bore in the block and the seal contact surface on the crankshaft. Check the crankshaft surface for scratches and nicks that could damage the new seal lip and cause oil leaks. If the crankshaft is damaged, the only alternative is a new or different crankshaft.
- 7 Apply a light coat of engine oil or multi-purpose grease to the outer edge of the new seal. Lubricate the seal lip with moly-base grease.

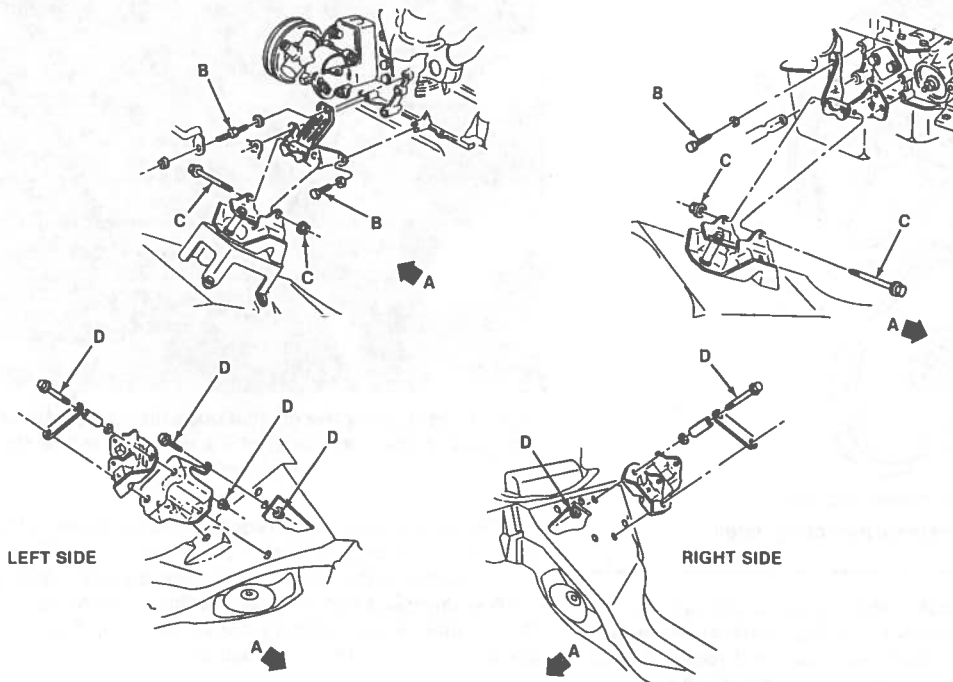


20.8a Installing the rear main oil seal with GM special tool no. J-34924

- | | |
|--------------------------------|------------|
| 1 Alignment hole in crankshaft | 4 Collar |
| 2 Dust lip | 5 Mandrel |
| 3 Dowel pin | 6 Screws |
| | 7 Oil seal |



20.8b Tap around the outer edge of the new seal with a hammer and punch to seat it squarely in the bore



21.5 Engine mounts – exploded view

- | | |
|---|---|
| A | Forward |
| B | 36 ft-lbs |
| C | Tighten bolt to 50 ft-lbs, nut to 31 ft-lbs |
| D | Tighten bolt to 45 ft-lbs, nut to 36 ft-lbs |

8 Press the new seal into place with GM tool no. J34924 (if available) (**see illustration**). The seal lip must face toward the front of the engine. If the special tool isn't available, carefully work the seal lip over the end of the crankshaft and tap the seal in with a hammer and punch until it's seated in the bore (**see illustration**).

9 Install the flywheel or driveplate.

10 If equipped with a manual transmission, reinstall the clutch disc and pressure plate.

11 Reinstall the transmission (see Chapter 7).

21 Engine mounts – replacement

Refer to illustration 21.5

Warning: Improper lifting methods or devices are hazardous and could result in severe injury or death. DO NOT place any part of your body under the engine/transmission when it's supported only by a jack. Failure of the lifting device could result in serious injury or death.

1 If the rubber mounts have hardened, cracked or separated from the metal backing plates, they must be replaced. This operation may be carried out with the engine/transmission still in the vehicle.

2 Disconnect the negative cable from the battery.

3 Raise the front of the vehicle and support it securely on jackstands.

4 Support the engine with a jack. Position a block of wood between the jack head and the oil pan.

5 Remove the engine mount-to-chassis bolts (**see illustration**).

6 Remove the mount-to-engine support bracket bolts. It's not necessary to detach the support bracket from the engine.

7 Raise the engine just enough to clear the bracket, then remove the engine mount.

8 Place the new mount in position.

9 Install the mount-to-engine support bracket bolts and tighten them securely.

10 Tighten the mount-to-chassis bolts securely.

11 Remove the jack.

12 Remove the jackstands and lower the vehicle.